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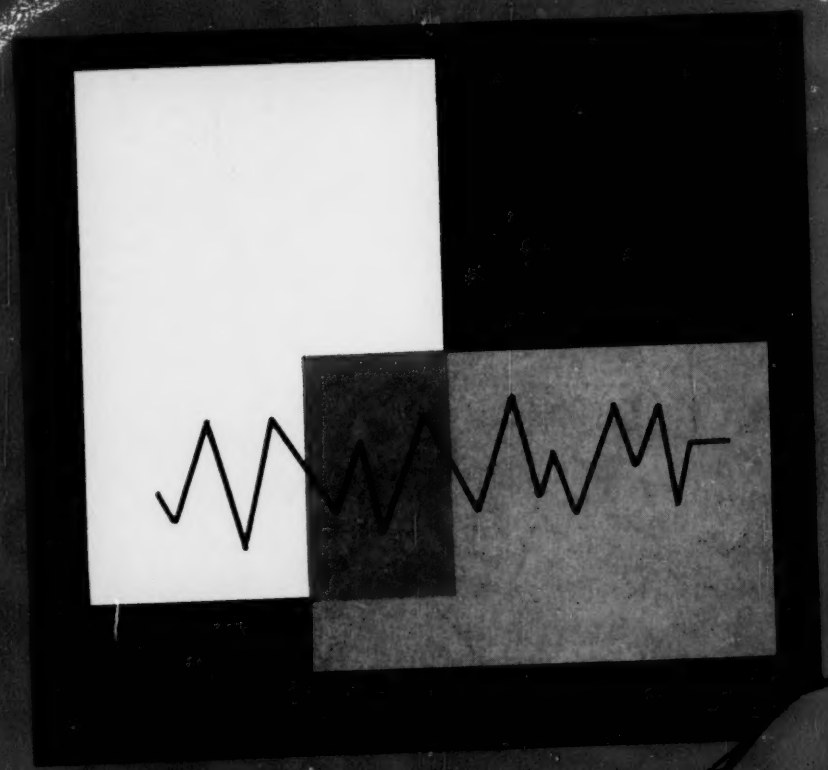
Chemical Engineering

A McGRAW-HILL PUBLICATION



FUNDAMENTALS OF PATENTS

. . . Recent developments threaten your patent engineering program. How? See page 121.

EAK . . . a high-boiling solvent with a future

In formulations for surface coatings, ethyl amyl ketone complements low-boiling MEK and medium-boiling MIBK by promoting better flow and gloss and eliminating dry overspray.

EAK possesses excellent blush resistance, good diluent tolerance and high solvency for surface coating materials. Its slow evaporation rate contributes to excellent flow-out, tends to minimize pinholing and bubbling in the film.

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FEBRUARY 24, 1958

JOHN R. CALLAHAM, Editor-in-Chief

New Emphasis on Patents

Today, more than ever, the chemical engineer must become thoroughly familiar with the fundamentals of U. S. patent laws.

This was underscored just a few weeks ago when a sweeping product patent on linear or high-density polyethylene was awarded to DuPont.

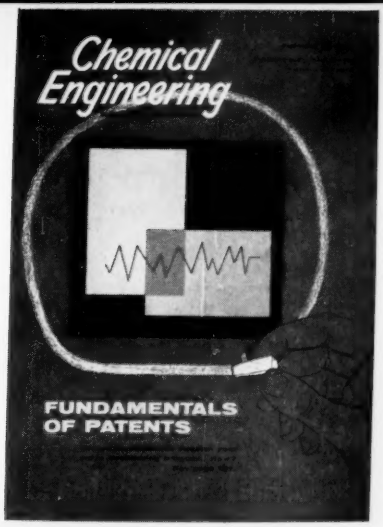
New precedents in patent law might well result from the DuPont patent, so basic and broad-sweeping are its implications. It is almost certain to go down as one of the chemical industry's all-time patent cases.

This is one of the reasons why we feel this issue's 16-page report on patent fundamentals becomes urgent reading for chemical engineers everywhere. For the final decision in this case—already probably the most-discussed product patent in recent decades—could influence the course of chemical research and development for years to come.

This issue's report on patent fundamentals—a subject our reader research has shown to be almost universal in interest—focuses attention on six critical areas:

- What is a patent?
- What is a patentable invention?
- How to prepare an application.
- What is a patent worth?
- How to make a patent search.
- How to safeguard your secrets.

After you've read this 16-page report we'd like to hear from you. It's a subject that's been in popular demand from many of our readers, so we'd like to know if we've filled the bill.



FOURTH OF TWENTY-SIX ISSUES

4/26

GUIDED TOUR

Patents are like fences and now they may enclose as well as exclude

Patent claims and counterclaims may overlap. Suits and countersuits may result. It's all of no consequence—as our cover artist colorfully shows you—if somebody can fence in all claims with a product patent. This is a new and significant development in patent law. So now's the time to check your whole patent picture. (p. 121)

Captive methanol at 70 tons per day

Dropped into a now-integrated plant, synthetic methanol process closes chain between natural gas and pentaerythritol. New form of catalyst is key to cost cutting.

How to make secret ingredients

There's a lot of chemical engineering skill behind the perfumer's exotic products.

Chemical

GUIDED TOUR

Here's a peek at the processes used to make four of his extremely-high-purity aromatic raw materials. (p. 112)

Timely data on impervious graphite

What's available and what will it cost today? These two big questions are answered for impervious graphite processing equipment. It's your guide to intelligent use of a relatively new material. (p. 137)

Good-by to spill-damaged coatings

Eighteen months of rugged tests now reveal a near-perfect coating. A dozen others are nearly as good. One will resist those acids, alkalis and solvents that inevitably get spilled in your plant. (p. 156)

Your success will come from extras

Here's what it takes—over and above knowing your job—to advance toward success. Six keys without which the way will surely be closed. Now let these extras work for you, not against. (p. 165)

CE is edited for the engineer concerned with chemical operations, whatever his function . . . administration, production and plant operations, design and construction, research and development, sales and purchasing. More engineers subscribe to CE than to any other magazine in the field. Print order of this issue:

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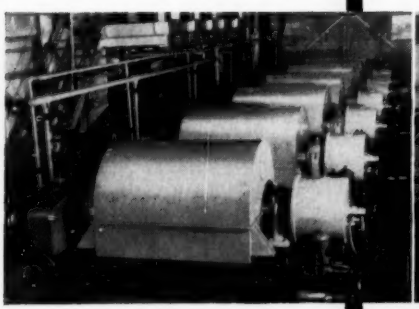

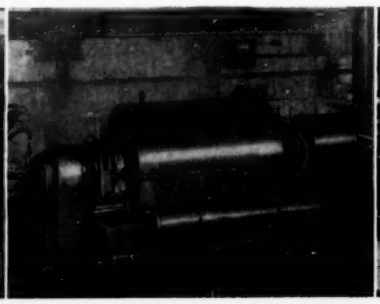

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Chemical Engineering

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Thanks to a highly acclaimed new catalyst and a strong assist from American engineering, Hercules Powder's new unit synthesizes methanol from natural gas.

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Where metal-fiber-laced epoxy is concerned, plastic tooling is no longer tied to short production runs. It boasts unusual strength, thermal conductivity, machinability.

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Now, precise orientation of monomer via just the right catalytic touch synthesizes solid polypropylene—soon to be a sturdy new factor in the propylene market.

Why oilmen are boning up on patents..... 121

A recently awarded patent in the petrochemical field has important implications on the future of your engineering projects. Brush up now on the fundamentals.

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In your refinery calculations..... 145

You often make use of second order linear differential equations. Here are the form and solution of these useful equations when coefficients are constant.

How to foil chemical spillage..... 156

Just before an inspection, every operator turns into a painter. Then, chemical spillage goes to work and the paint blisters. Here are the correct paints and know-how.

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GRINDING

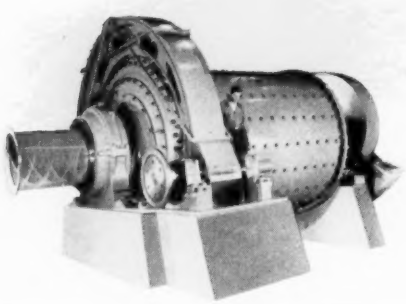
. . . built to exacting requirements for economical, high capacity reduction in the CHEMICAL-PROCESSING INDUSTRY

For well over half a century Nordberg has served the chemical-processing industry. Nordberg machinery has become well known all over the world for its advanced engineering, excellent construction, high efficiency and dependable service.

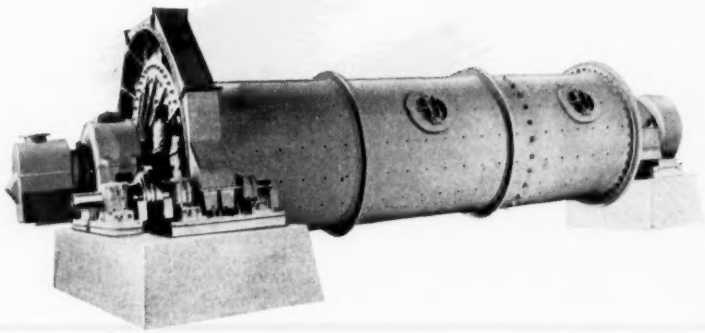
Nordberg Machinery for the chemical-process industry includes an extensive line of grinding mills . . . for wet or dry grinding of metallic and non-metallic minerals, chemicals, and in other processes where friable material must be comminuted to fine sizes.

Nordberg Grinding Mills are manufactured in sizes ranging from 6 to 13 feet in diameter and up to 50 feet in length. Types include Rod, Ball, Pebble, Tube and Compartment Mills. Nordberg also builds special mills and other heavy processing equipment to custom requirements. *Write for Bulletin 232.*

NORDBERG MFG. CO., Milwaukee 1, Wisconsin



• Typical Nordberg Ball Mill, measuring 10′-6″ in diameter by 16′ in length, with scoop feeder and overflow discharge. Mills of this type are widely used for efficient processing operations, delivering maximum output at lowest cost.



• View shows Nordberg 8′-6″ x 32′ Two Compartment Mill. Built in sizes to 50-ft. in length, these modern mills are widely used in cement plant processing operations in all parts of the world.

SYMONS GYRATORY CRUSHERS

SYMONS CONE CRUSHERS

NORDBERG KILNS AND COOLERS

NORDBERG MINE HOISTS

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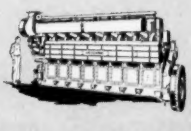
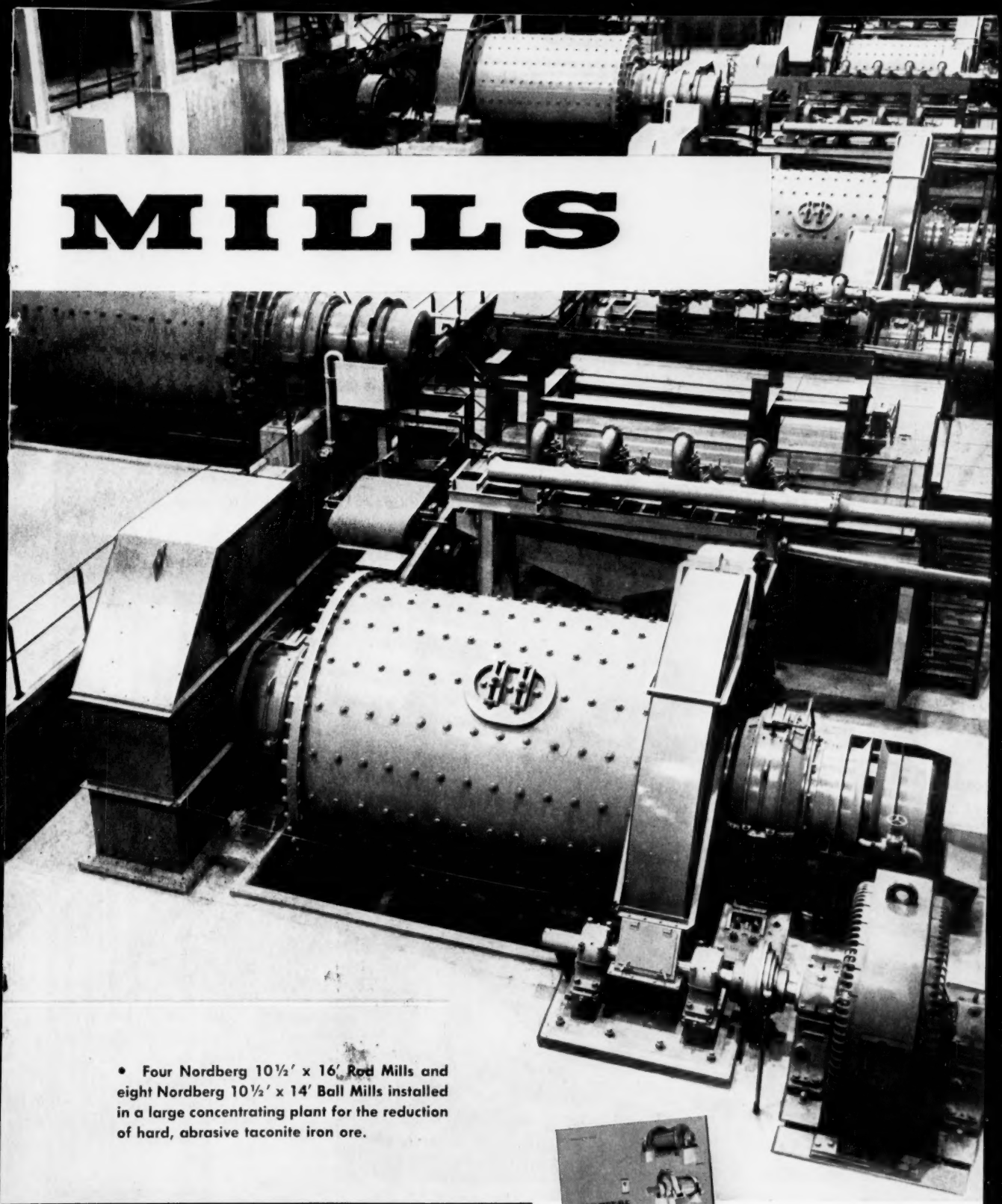


NORDBERG DIESEL • DUAFUEL® and SPARK-IGNITION GAS ENGINES

MILLS



• Four Nordberg 10½′ x 16′ Rod Mills and eight Nordberg 10½′ x 14′ Ball Mills installed in a large concentrating plant for the reduction of hard, abrasive taconite iron ore.

NORDBERG MACHINERY

NORDBERG

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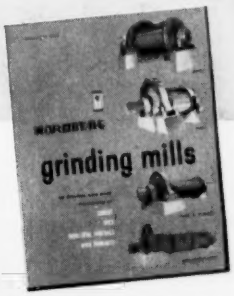

Send For This NEW BULLETIN—This new Nordberg Bulletin 232 fully illustrates and describes the full line of Nordberg Grinding Mills for the efficient, low cost processing of ores and industrial minerals. Write for your copy today.

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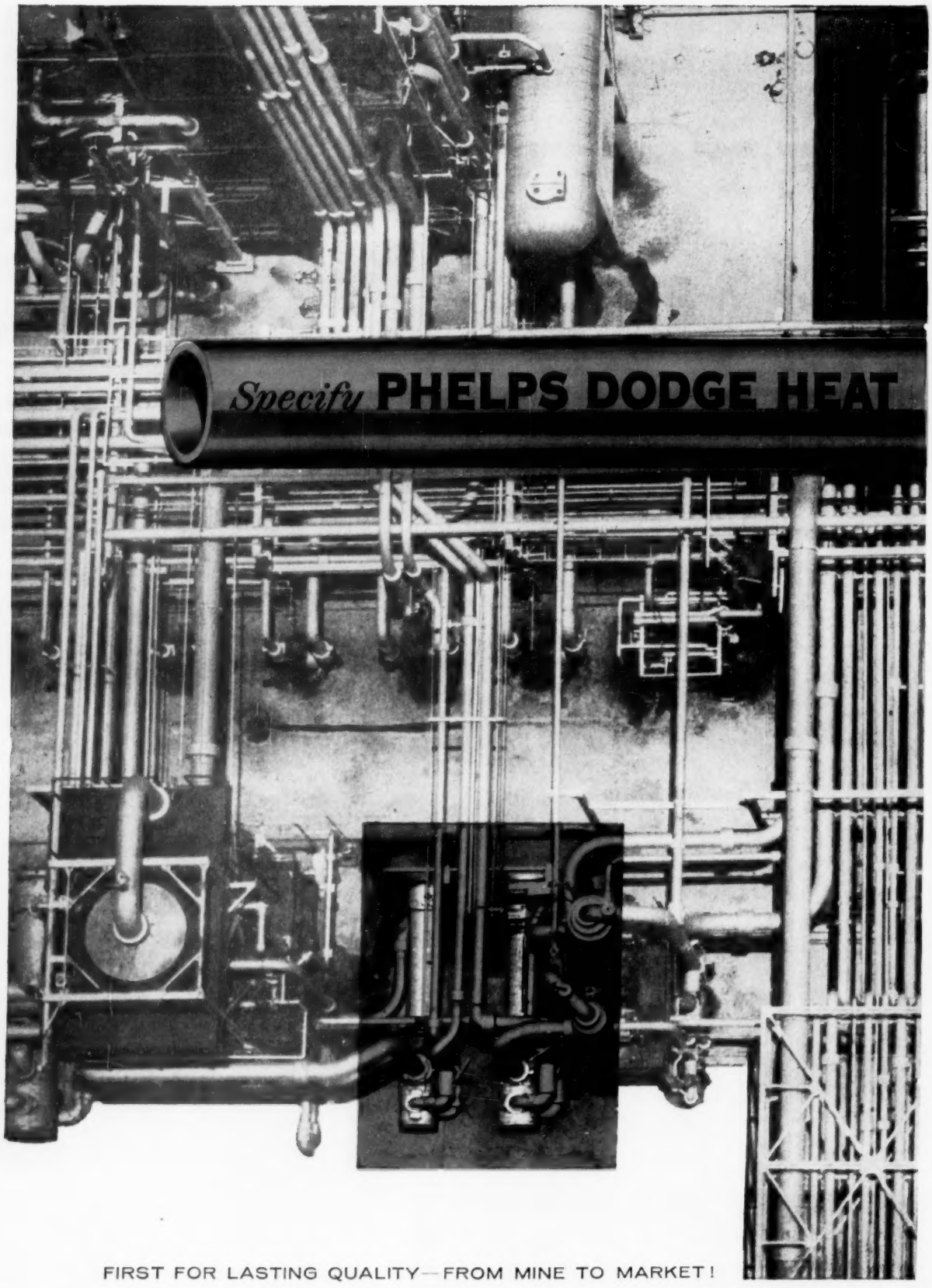

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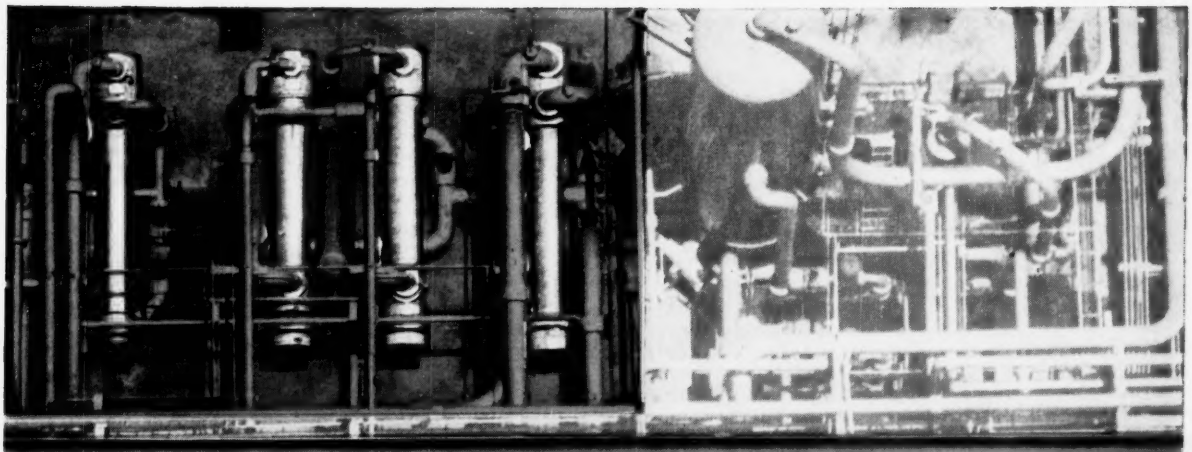

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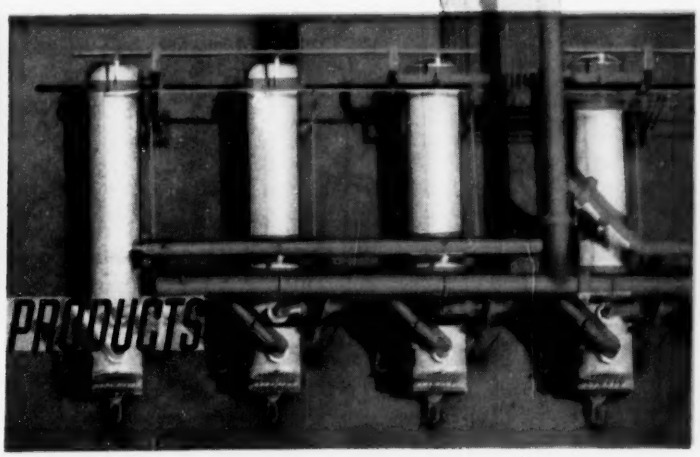

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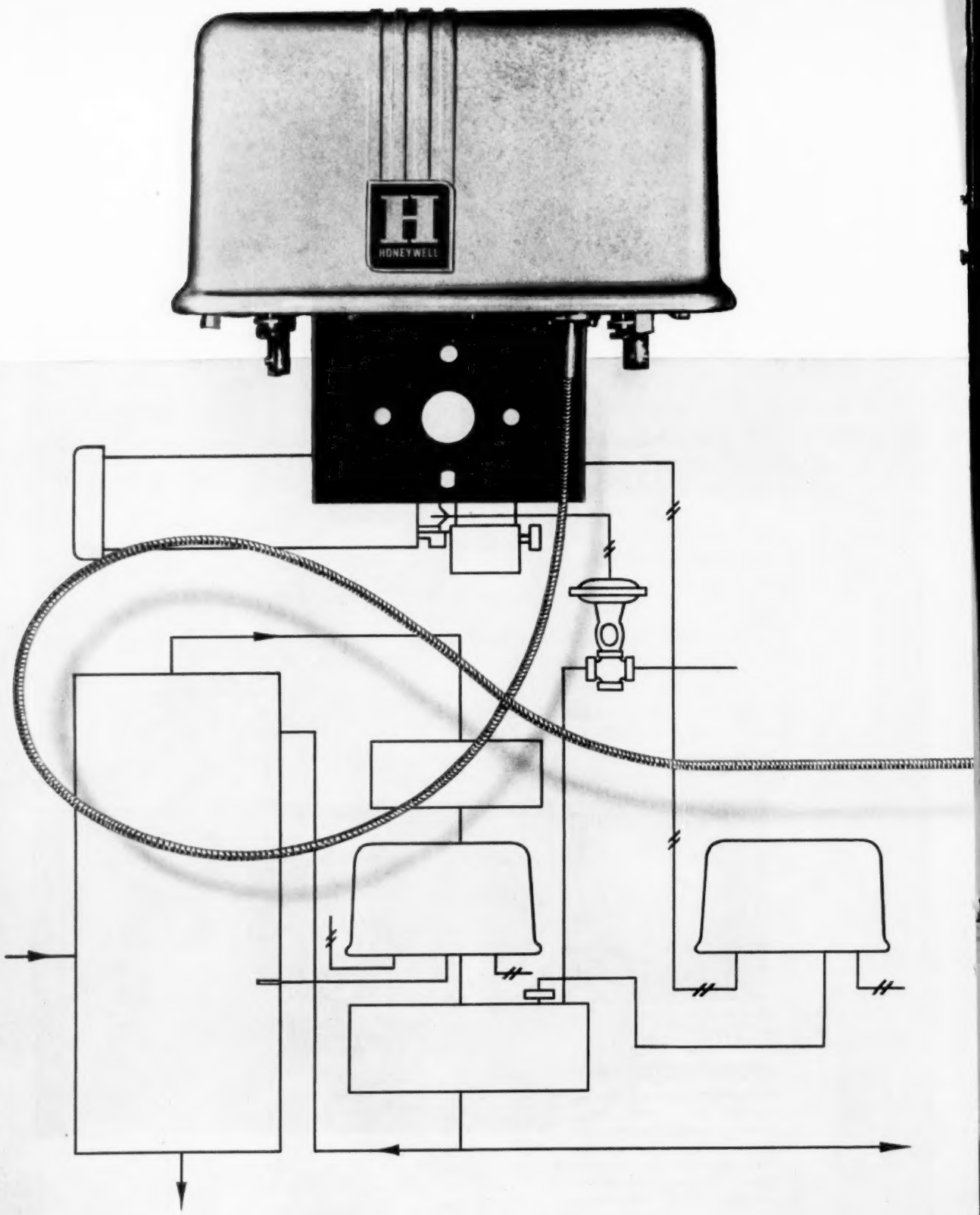
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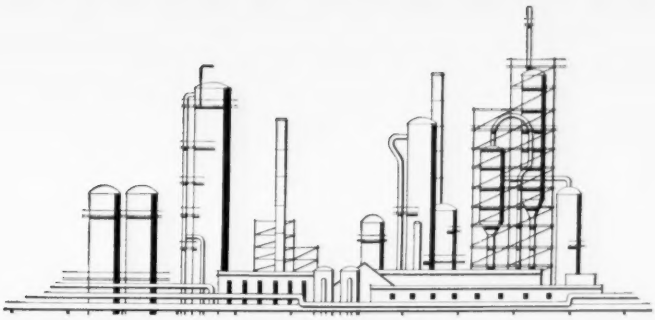

One basic TEL-O-SET transmitter serves all applications

TEMPERATURE SENSING ELEMENT has small bulb for fast response. Either plain or coiled bulbs are standard, with or without union connections. For food processing applications, bulb is available with union connection for Type 3A4 sanitary fitting.

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- Measures temperature, gage pressure or absolute pressure.
- Requires only one thermal system and one pressure system for all ranges. Changeover from temperature to pressure measurement is extremely simple.
- Span can be shifted to cover any part of the overall transmitter range—from 40 to 600 psi, or from –375 to 1000°F—*without changing or adding parts.*
- Equally accurate at small spans of 20 psi and 50°F or at wide spans of 150 psi and 400°F.
- High-speed response to temperature or pressure changes permits control within close tolerances.
- Ambient temperature and pressure compensated. Vibration resistant.

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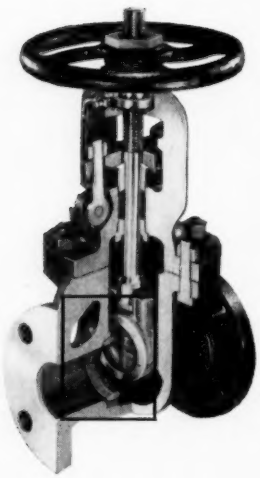
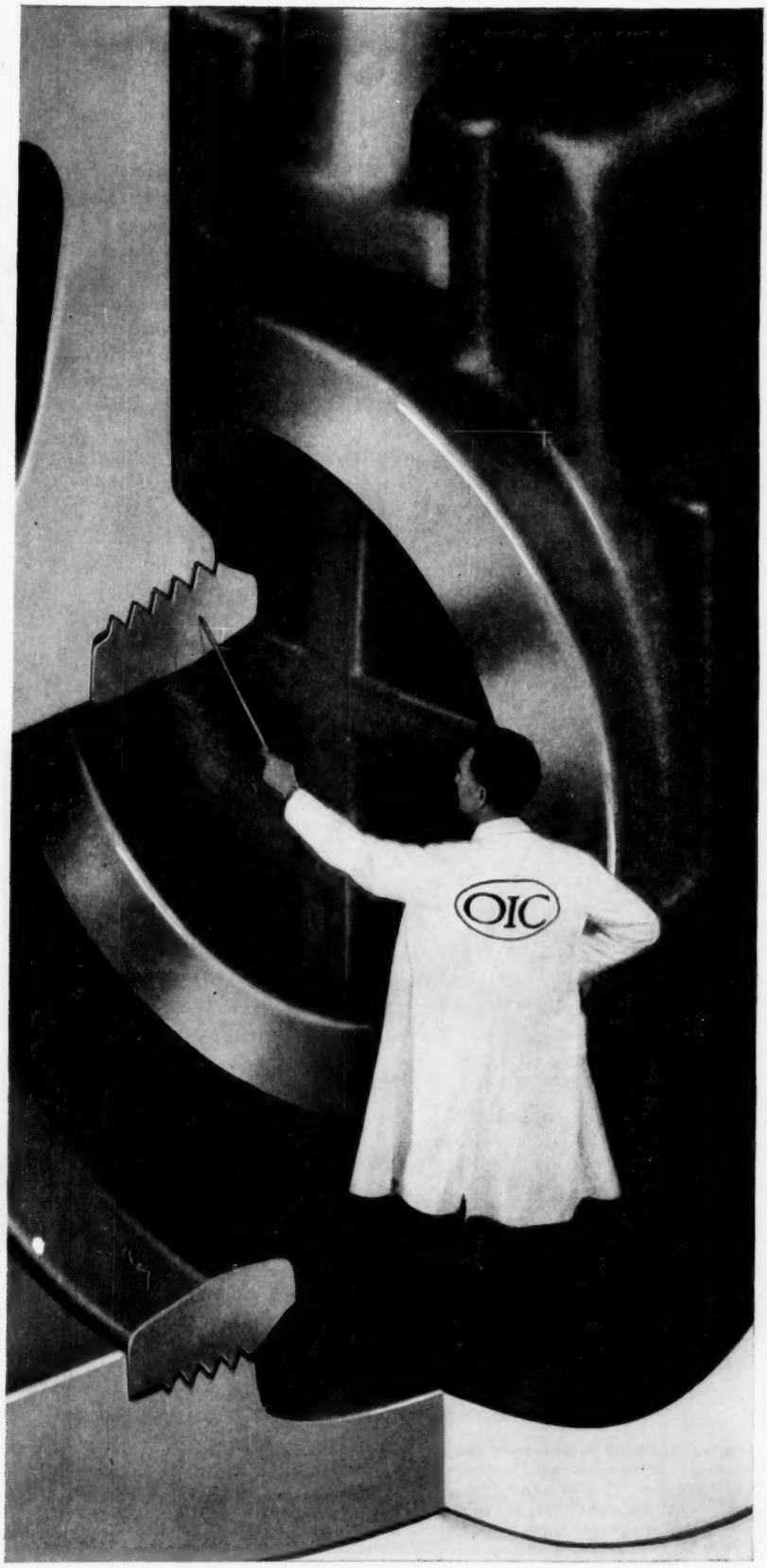


...and here's that same leakproof, streamlined seat ring– a steel valve feature, so good, we put it on our iron valves, too

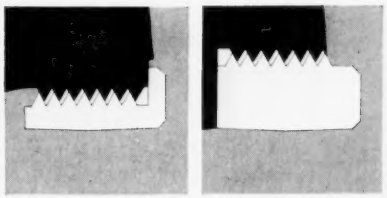
OIC VALVES

BRONZE, IRON, FORGED AND CAST STEEL LUBRICATED PLUG VALVES



See how this *end*-seated ring fits into the valve body, out of the flow. It streamlines the body port, eliminates excessive pressure drop across the valve.

Here's how these rings reduce your maintenance problems . . .



Old-style, shoulder-seated ring cross section

OIC *end*-seated ring cross section

Old-style *shoulder*-type rings interrupt flow, cause turbulence. Since rings are seated in *tension*, they loosen and leak.

These OIC streamlined rings are *end*-seated in *compression* against the body. They can't loosen, even in continuous operation, so they won't leak.

3 OIC iron valve features that add to your maintenance savings

Yokes in all sizes permit replacement of the yoke nut when the valve is wide open, without interrupting flow.

T-head stem-wedge connection prevents wedge from binding when closing the valve. Closing is easy, positive, least wearing to trim parts.

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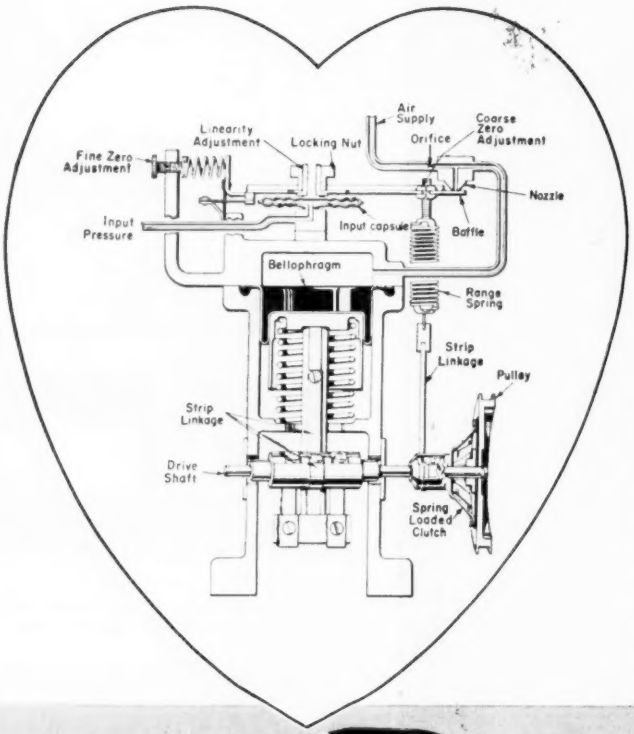
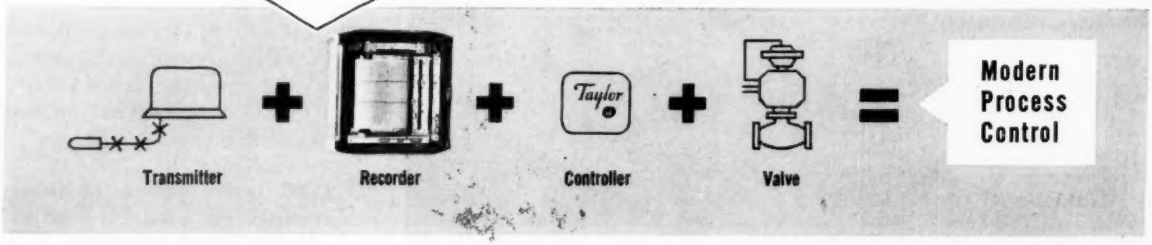
WADSWORTH, OHIO

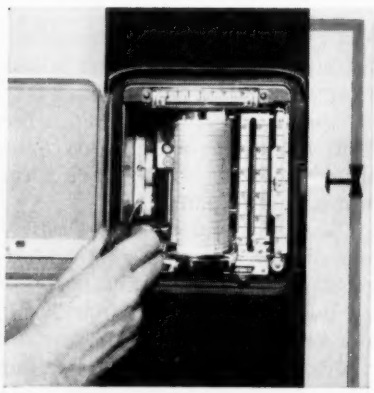
New Taylor TRANSCOPE*



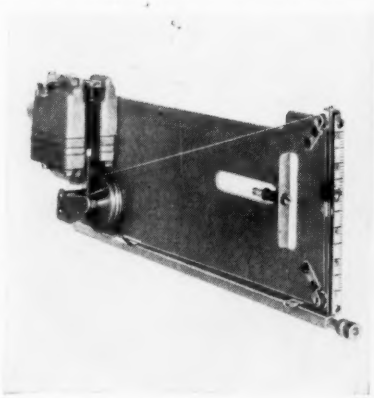
"SERVOMATIC" MOTOR assures lifetime accuracy of pen position. Transmitter signal is received and amplified by individual force balance servo-mechanisms. Efficient spring feedback and powerful longstroke pneumatic motor give *150 times greater power than normally available for pen positioning.* This means greater accuracy; less service needed. If you like servo-operated devices . . . power steering, power brakes . . . you'll want SERVOMATIC powered pens.

0.1% THRESHOLD SENSITIVITY—A NEW STANDARD OF ACCURACY. Responsiveness to transmitter output is 0.1%; and because of the very small pneumatic displacement of the input capsule, the response is practically instantaneous. You see more minute process changes, enabling you to make optimum control settings to increase yield of specification product. All servos are identical and interchangeable. Servo-pen connection is by means of cable . . . no long, jointed, flimsy links or levers. Allows perfect linear conversion from rotary motion . . . repeatability is truly amazing.

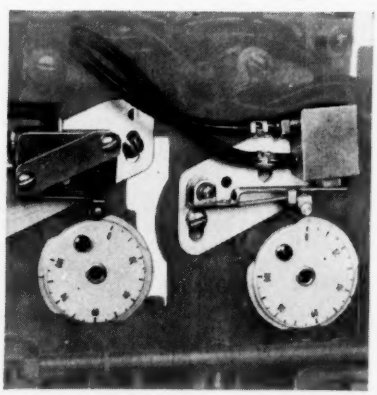




Controller Settings are made from the front while recording. Gain, reset and PRE-ACT* dials are calibrated in specific units. Eliminates blind adjustments; settings and results are seen in one-spot . . . the front of the panel.



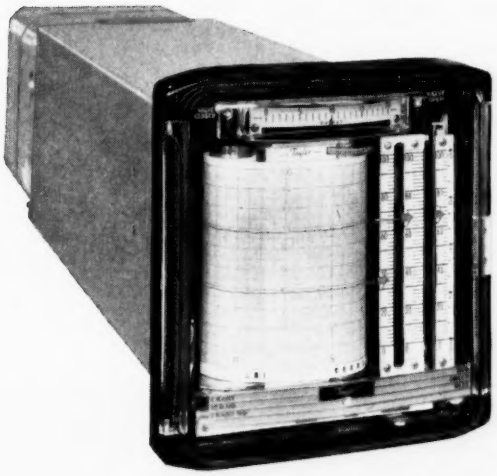
Exclusive "Set Point Transmitter" allows continuous automatic control during recorder removal. Plug-in transmitter assembly may be removed and control valve sealed in operating position. Perfect for continuous processes.



Optional Alarms. Each SERVOMATIC motor can operate either an electric or a pneumatic alarm. Each alarm can be adjusted for one high and one low, or two high, or two low operating points. Microswitch on left, air valve on right.

Recorder brings you . . .

REVOLUTIONARY ACCURACY, BIG-INSTRUMENT FEATURES



"No other recorder, regardless of size, puts so many features in so little panel space."

Front of Panel Control Settings let you make adjustments easier, quicker, and better . . . *from the front of the panel* . . . while recording! You can clearly see what you are doing, and the results, because the record is continuous.

Stays on Automatic Control while the recorder is removed for inspection. The unique Set Point Transmitter remains plugged in the case, providing continuous fully automatic control.

Complete Indicating Control Station while recorder is removed. You see the variable. There's no need to shut down the process for instrument service or adjustments. Horizontal gage at top of recorder will show either process variable or air output to valve, as desired.

Receives Three Variables to be recorded or indicated; has a Set Point Transmitter, an Automatic-to-Manual switching lever, a Cascade or process-output indicator, and many other features . . . all in a compact case.

For further information about this revolutionary new recorder, see your Taylor Field Engineer, or write for **Form No. 98282.** Taylor Instrument Companies, Rochester 1, N. Y., or Toronto, Ontario.

*Trade-Mark

MADE FOR EACH OTHER!

The Taylor TRANSCOPE Controller and Recorder are companion instruments. Together they give you new standards of process control performance . . unprecedented accuracy and adaptability. Ideal for the time constants of modern processing, exceptionally fast and responsive to adjustments, the TRANSCOPE Controller is also highly adaptable and simple to maintain. Write for **Bulletin 98278.**

Taylor Instruments

MEAN

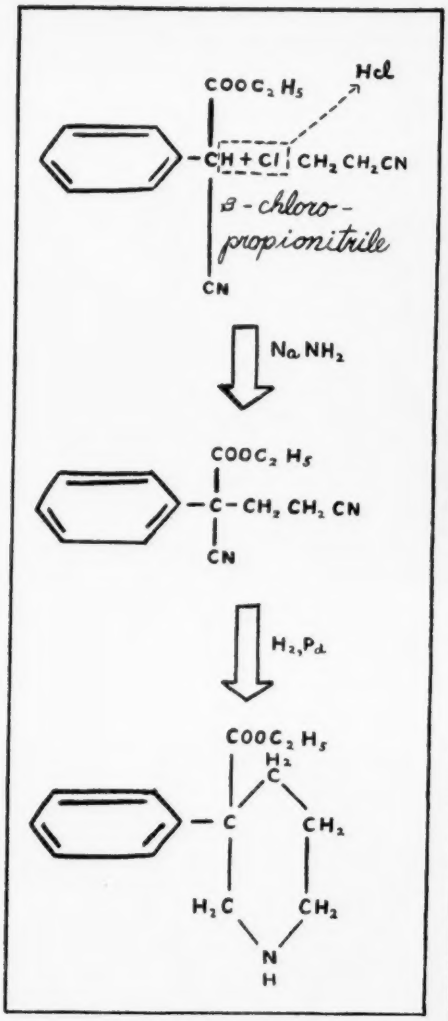
ACCURACY, FIRST

VISION · INGENUITY · DEPENDABILITY

Life on the Chemical Newsfront

PLASTIC KEYS CONDUCT AN ORCHESTRA OF LIGHT. The Lumitron Lighting Control System permits one operator to play infinite variations in the stage-lighting effects using handles and slide bars molded of BEETLE® *urea plastic*. BEETLE, an excellent dielectric, requires no insulation. Molded-in colors are permanent, permit quick circuit identification for console operator. Developed by Metropolitan Electric Manufacturing Company, the Lumitron has an excellent record of dependable performance. **(Plastics and Resins Division)**

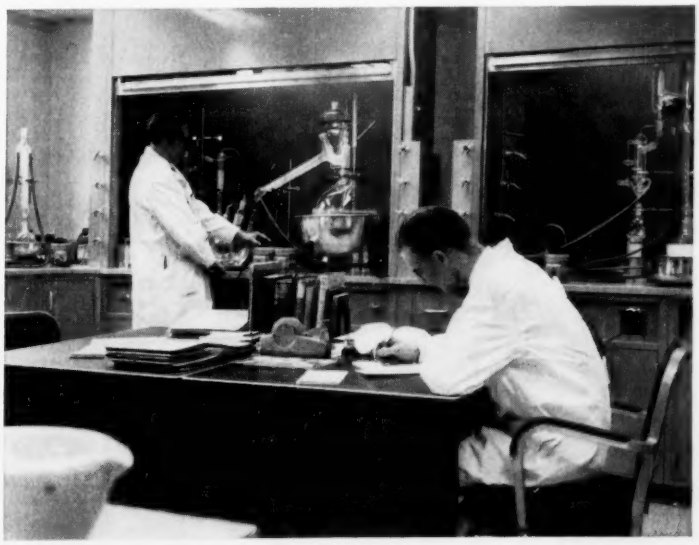
HOW MORE THAN 5000 CYANAMID CHEMICALS for industry, farm, home and health contribute to everyday living is dramatized in Cyanamid's new exhibit hall at 30 Rockefeller Plaza in New York. Product exhibits, dioramas, slide films and movies combine to present an over-all picture of Cyanamid's diversified chemical activities. Commentaries on the several exhibit areas are provided by pickup phones. Drop in when you are in New York . . . your family will enjoy the exhibit, too!



A ROUTE TO HETEROCYCLICS is just one of the reaction possibilities of *β-chloropropionitrile*. This double-ended molecule combines an aliphatic nitrile with an activated alkyl chloride, and either group can be reacted separately. Illustrated is the condensation with an arylacetonitrile to form a glutaronitrile. Catalytic hydrogenation yields the heterocyclic 3-phenyl-3-carbethoxy piperidine. A technical bulletin on β-chloropropionitrile is available on request.
(Market Development Department*)

***NOTE THIS NEW NAME** . . . for the New Products Development Department. The functions of the group are unchanged – providing assistance in developing practical applications for Cyanamid's new chemical products.

NEW ACRYLIC-FIBER PAPERS are showing considerable promise. Their excellent dimensional stability suggests their use in layout or lofting papers for mechanical design work. In filter papers, high wet strength, chemical resistance and lack of absorption lead to efficient filtration. Acrylic fibers, such as Cyanamid's CRESLAN® are polymers or modified polymers of *acrylonitrile*. Increased demand for this reactive monomer is being met by expansion of Cyanamid's acrylonitrile production facilities at Fortier, La. (Organic Chemicals Division and Fibers Division)



IMPROVED STEROIDS are the goal of highly developed synthesis techniques at Lederle Laboratories. By modifying the chemical structure, the remarkable curative properties of a steroid drug can be maintained while minimizing or eliminating undesirable side effects. A recent successful development of this work is ARISTOCORT® *triamcinolone*. Primary investigation has shown ARISTOCORT, available only on prescription, to have considerable promise in a widening field of steroid therapy. (Lederle Laboratories Division)

CYANAMID

AMERICAN CYANAMID COMPANY
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

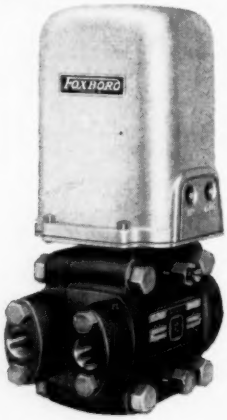
For further information on these and other chemicals, call, write or wire American Cyanamid Company

GET THE BEST SOLUTION TO EVERY FLOW

. . . with Foxboro Instrumentation

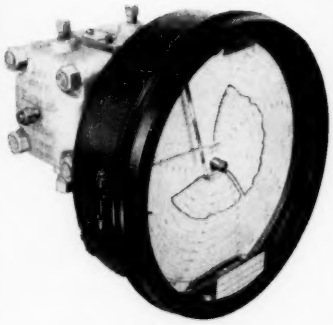
Differential Pressure Cell Transmitters

Complete line includes air-operated and electric-operated d/p Cell Transmitters covering ranges from 0-20" to 0-850" of water; working pressures up to 4000 psi.



Type 13A d/p Cell Transmitter

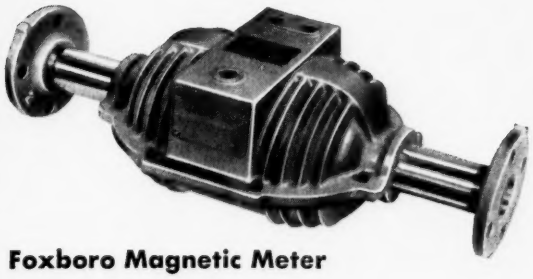
- Positive Overrange Protection—up to full 1500 lbs. rating
- Fully Adjustable Ranges—0-20" to 0-850" water
- Automatic Internal Damping — fast, stable measurement
- Simplicity—easiest, lowest-cost installation, lowest maintenance



Type 37 Diaphragm Meter

- Uses no mercury
- Positive overrange protection at static pressures up to 2000 psi
- Exclusive Features — Built-in temperature compensation never needs change or adjustment; twin-spiral range springs readily accessible for easy range changing
- Unique packless drive bar transmits linear motion to pen arm
- Ranges of 20", 50", 100", 200"; available in round or rectangular cases; 316 stainless or carbon steel body

PROBLEM



Foxboro Magnetic Meter

- Measures Fluid Velocity Directly
- Adds No Pressure Drop
- Uniform Flow Scale
- Overall Accuracy Better than 1% of Range Over Entire Scale
- Full Accuracy Sustained Even on Liquids Other Meters Can't Handle — even sand and water slurries

THERE ARE two logical reasons why Foxboro Instrumentation assures you optimum results in measurement or control of process fluid streams. First: Foxboro offers the widest variety of measuring and controlling devices . . . the right equipment for every application. For example, only Foxboro offers all these basic meter types: differential pressure cell flow transmitters, magnetic meters, mercury meters, and weir meters. Second: Foxboro provides 45 years of engineering experience in every phase of fluid mechanics.

From the simplest general utility-type instrument to complex automatic ratio control systems, you get highest accuracy, efficiency, and economy. Whenever you have a flow problem involving liquids, vapors, gases or slurries — in pipes, ducts, or channels, you can solve it best by specifying Foxboro.

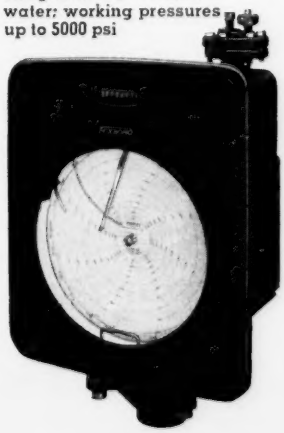
Only a few instruments are described on these pages. For full details, or for specific information on your problem, contact your nearby Foxboro Field Engineer, or write **The Foxboro Company, 362 Neponset Ave., Foxboro, Mass.**

FOXBORO
REG. U. S. PAT. OFF.

FIRST IN FLOW

Mercury Type Meters

- Permanent Full-Scale Meter Accuracy — exclusive segmental lever design provides linear transmission from float to pen
- High-Powered Pen Drive—large float with long travel
- Minimum Ambient Temperature Effects — float located in high pressure chamber
- Ranges from 2" to 400" of water; working pressures up to 5000 psi



Other Foxboro Flow Instrumentation

Float-and-Cable Type Meters

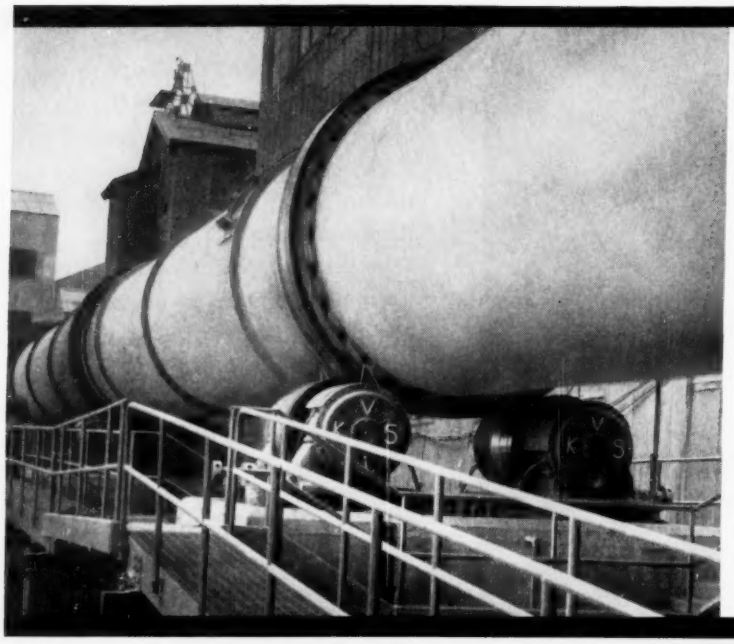
Electric or Pneumatic Type Rotameters

Electric, Pneumatic, and Mechanical Integrators

Planimeters

All Primary Elements, Valves, and Accessories required for complete flow measurement and control systems

KENNEDY ROTARY KILNS



for

Lime

Calcined Coke

Dead Burned Dolomite

Cement—Wet or Dry Process

Nodulizing and Agglomerating

Drying

This 11 ft. diameter by 375 ft. KENNEDY Rotary Kiln processes 2,960 barrels of cement per day.

KENNEDY Kilns have a reputation for steady, high production—for economical operation—for low maintenance—and for long life. You can expect higher profits with a KENNEDY Kiln.

Compare these KENNEDY features:

- Self-aligning bearing pedestals
- Stationary firing hood with swinging entrance ports for quick, easy internal access
- Truly effective air seals
- Drive gear mountings avoid thermal stresses
- Built in any length or diameter
- Designed to give economical, efficient operation over long periods

FOR ADDED ECONOMY—Preheaters for your new or existing kilns:

KENNEDY Multivane Internal Recuperator—KENNEDY-Grudex Preheater—KENNEDY External Stone Preheater

Primary & Secondary Gyratory Crushers
Jaw Crushers
Roll Crushers
Impact Breakers
Hammer Mills
Ball, Rod & Tube Mills
Rotary Kilns
Dryers
Preheaters & Coolers
Complete Cement and Lime Plants
Pneumatic Conveying Pumps
Air Activated Conveyors
Complete Pneumatic Conveying Systems
Pulverized Coal-Gas-Oil Firing Systems

KENNEDY • VAN SAUN
MANUFACTURING & ENGINEERING CORPORATION
TWO PARK AVENUE, NEW YORK 16, N.Y. • FACTORY: DANVILLE, PA.

—Photo courtesy Standard Oil Company (N.J.)

How soon will you be forced to recover stack BTUs?

The constant rise in cost of fuels means simply this: it is becoming more and more uneconomical to dissipate so much of your fuel up the stack. Particularly, since so much of it – nearly one third – can be put *back to work.*

For with modern process equipment, which includes a Ljungstrom Air Preheater, you can save as much as 30% of the fuel burned! That's a *saving of 1½ barrels in every five.*

Heat recovery can also be used to generate higher flame temperatures and increase heat-transfer rates. This makes it possible to *raise through-put as much as 25%.*

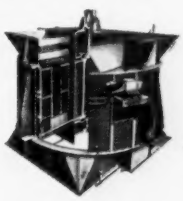
LJUNGSTROMS ARE WRITTEN OFF FAST

Ljungstrom has many other advantages. More complete combustion greatly reduces slagging . . . makes possible use of lower grade fuels . . . helps raise product quality. With these added benefits it's not difficult to see why a Ljungstrom is often paid out in less than a year.

For more complete data on what Ljungstrom Air Preheater can do to help you save on production costs . . . and for an analysis of the heat recovery benefits obtainable in fuel burning equipment – call or write the Air Preheater Corporation.

Wherever You Burn Fuel, You Need Ljungstrom

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.



The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

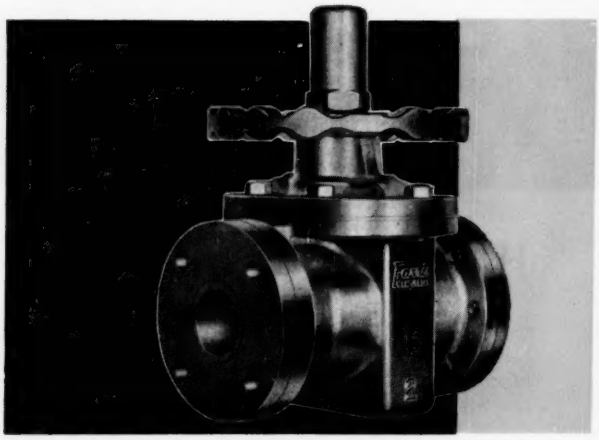
Farris

FLEX SUPERSEAL VALVE

If it goes through a pipe – it will go through a Flex Valve

The perfect valve for industry's toughest service! The Farris SUPERSEAL combines all the outstanding advantages of the standard 26-year job-proven flexible valve plus the added safety and performance of a complete metal enclosure...sealing in all movable parts and the flexible body itself. SUPERSEAL valves are ideal for full-pipe-capacity service under higher pressures, carrying a variety of materials from corrosive acids and chemicals to wet cement and wood chips!

SUPER SAFETY! Pressure tight housing fully encloses the flexible body, preventing escape of corrosive or toxic fluids when excessive wear takes place on the flexible body; patented flare-type dual seal insures complete protection for all working parts; cast housings available in alloys to meet your needs...SUPER ECONOMY! Self-supporting for money-saving installation and maintenance; inner valve bodies outwear metal 11 to 1; low cost valve bodies easily replaceable...SUPER SERVICE! Minimum hand-wheel effort; novel, self-aligning chain drive; minimum face-to-face dimensions; wide choice of accessories; choice of models for all requirements.

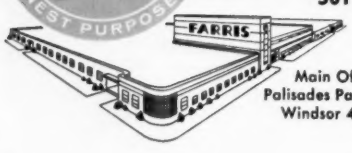


Series 5200
Manually Operated SuperSeal operates with minimum effort

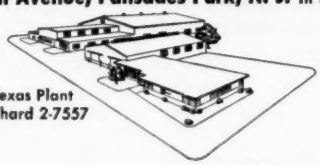
PROGRESS THROUGH HONEST PURPOSE

Farris **FLEXIBLE VALVE CORP.**

501 Commercial Avenue, Palisades Park, N. J. In Texas: 5405 Clinton Drive, Houston 20

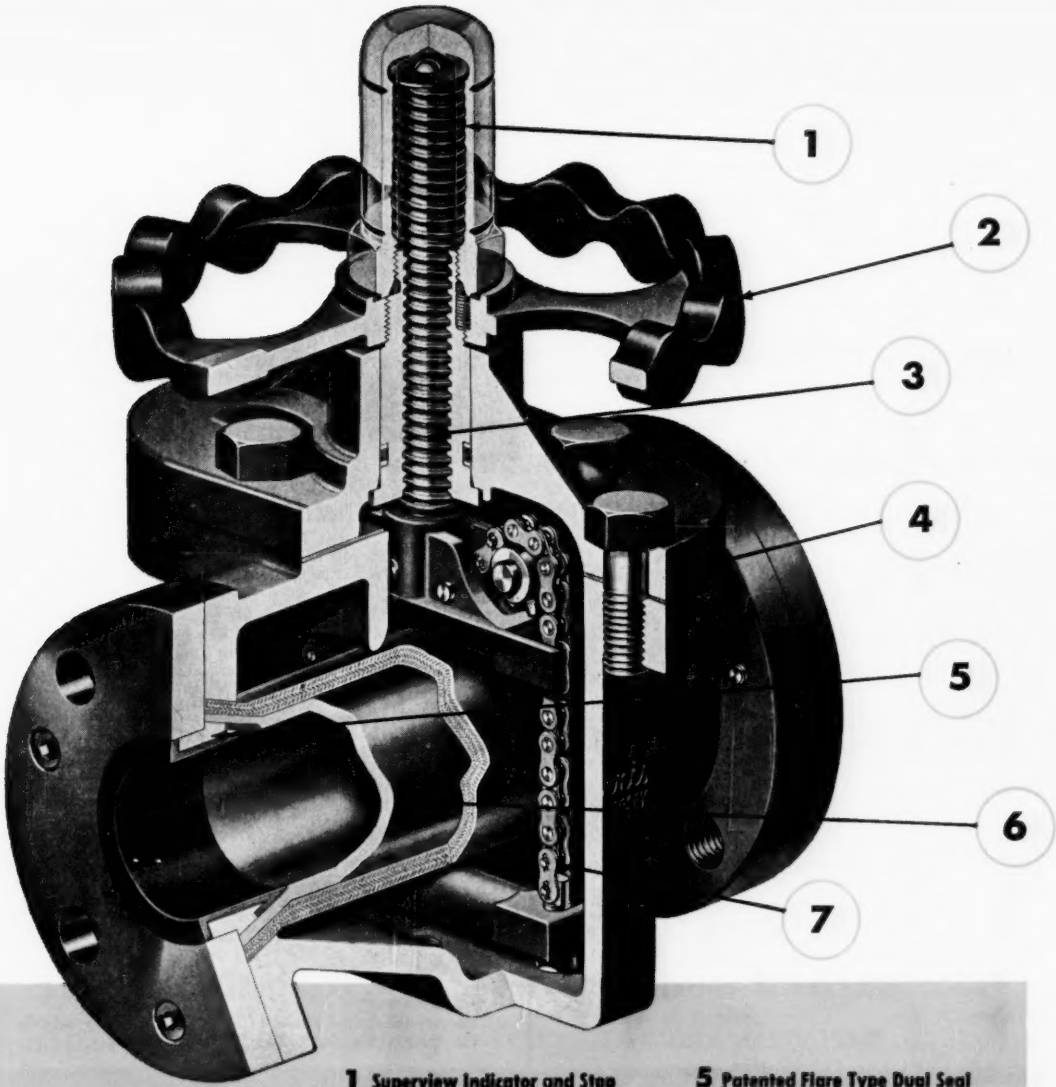


Main Office
Palisades Park, N. J.
Windsor 4-6300



Texas Plant
Orchard 2-7557

affiliates:
FARRIS ENGINEERING CORPORATION
FARRIS PICKERING GOVERNOR CO., INC.
FARRIS HYDROTORQUE CORPORATION
FARRIS HYDROSEAL CORPORATION



1 Superview Indicator and Stop

2 Non-Rising Hand Wheel—Minimum Effort

3 Durable Acme Thread—Stainless Stem

4 Completely Enclosed Metal Housing—Self Supporting

5 Patented Flare Type Dual Seal

6 Longer Life—Low Cost Body of Standard Fabric or High Strength Nylon

7 Self-Aligning Chain Drive

Series 5300 and 5400

Diaphragm Motor-Operated Superseal with valve positioner for automatic remote operation.

FARRIS FLEXIBLE VALVE CORP.
501 Commercial Avenue, Palisades Park, N. J.

Gentlemen: Tell me more about the Farris SUPERSEAL Flex Valve.

☐ Mail Catalog Information. ☐ Have your representative call on me.

NAME_____ TITLE_____

COMPANY_____

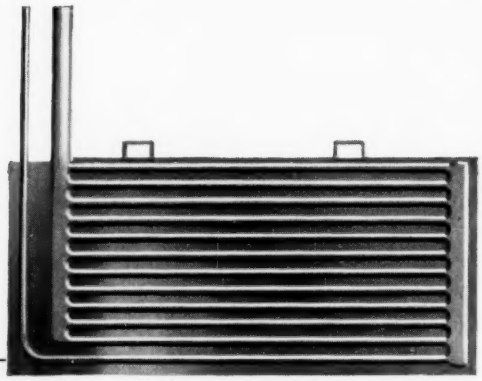
ADDRESS_____

CITY_____ STATE_____

CLIP THIS COUPON TO YOUR LETTERHEAD AND MAIL TODAY

PLATECOIL®

The answer to your special heat transfer problems



SAVES ON ENGINEERING, FABRICATING

INSTALLATION, OPERATION AND MAINTENANCE COSTS

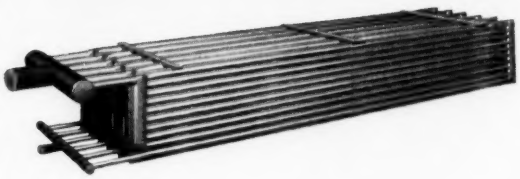
A Tranter PLATECOIL consists of two embossed metal sheets, seam and spotwelded together to form channels for the passage of heating or cooling media. Compact, lightweight PLATECOIL units are furnished in a wide range of standard sizes and styles. PLATECOIL saves space, requiring about half the space of a pipe coil of equivalent heat transfer area. Heat transfer is accomplished fully 50% faster by PLATECOIL as compared to pipe coils.

PLATECOIL Units are available in Cold Rolled Steel, Stainless Steel, Carpenter 20, Monel, and other corrosion-resistant alloys. In addition to the many sizes and styles available as standard PLATECOIL units, special units can be built on order to fit your specific requirements.

STANDARD OR SPECIAL FACTORY FABRICATED UNITS TO FIT YOUR NEEDS

DOUBLE OR SINGLE EMBOSSED

Standard units are double embossed. PLATECOIL units can be supplied with one side flat to meet special needs, as mounting directly on tank walls.



BANKED

Factory-fabricated banks of PLATECOIL are available for specific applications in heating or cooling.

ROLLED

PLATECOIL Units may be rolled to a specified diameter in the direction of width or length, in either single embossed or standard units.

WITH SURFACE FINISHES

PLATECOIL can be galvanized, metallized, electropolished, polished for food service; prepared for plate finishes, lead and thermo-plastic coatings.

STRUCTURAL PARTS

PLATECOIL can be incorporated into heated or cooled conveyors, tank walls, baffles or partitions.

SPECIAL CONNECTIONS

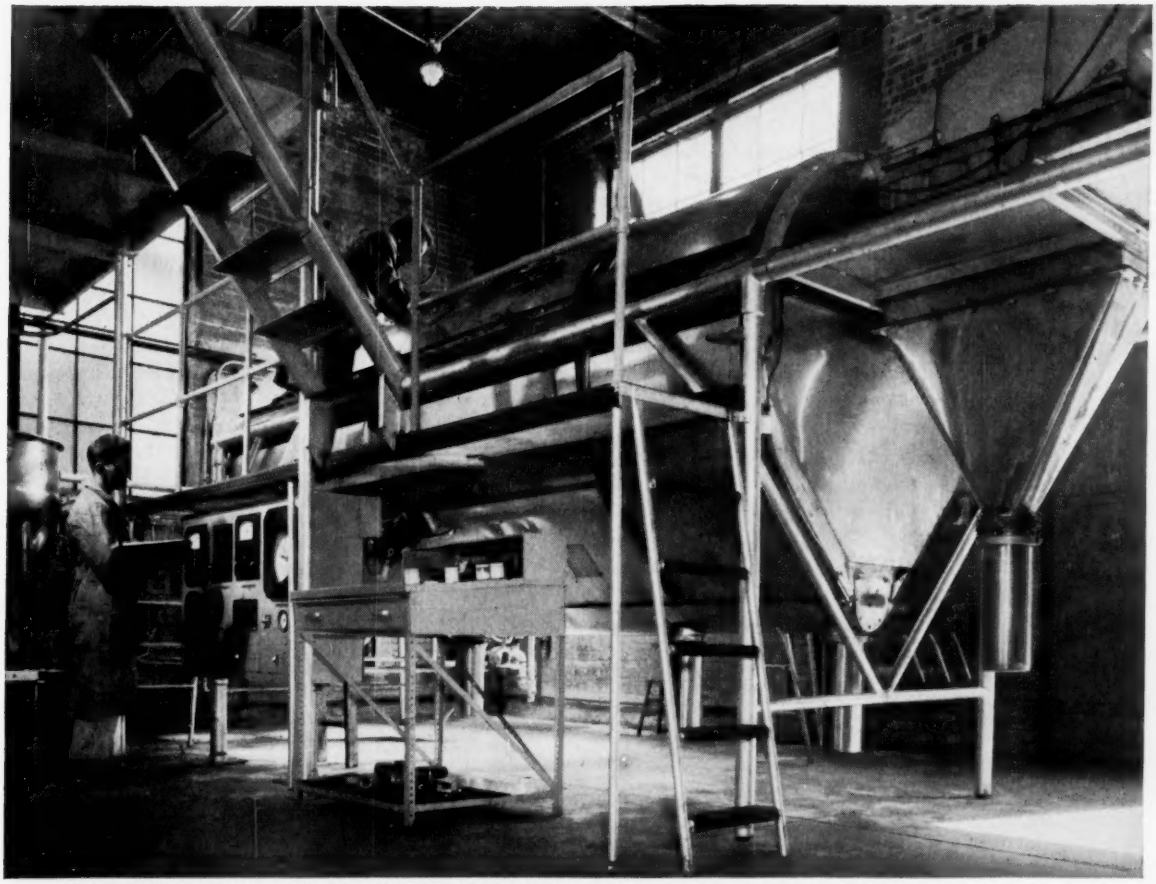
Pipe connections can be supplied longer or shorter than standard, at right angles, in couplings, pipe nipples or elbows; in various positions.

COMPLETE APPLICATION INFORMATION
WRITE FOR FREE
TECHNICAL DATA MANUAL P61

Tranter Manufacturing inc.

LANSING 9, MICHIGAN

PLATECOIL® DIVISION



RUNNING SPRAY DRYING TEST IN BUFLOVAK'S PROCESSING LAB. The lab contains a complete line of small scale and pilot size processing equipment for investigating drying, evaporation, extraction, impregnation, crystallization, and other processes. Here you can test a few beakers of material or run tank car quantities on a full time production scale.

Buflovak Spray Dryers—new horizontal high velocity design for instant drying... improved products...lower operating costs

Whether it's food or chemicals, Buflovak flash drying gives products new, more marketable characteristics.

Buflovak Horizontal Spray Dryers convert a liquid to a dry product instantaneously. Short exposure to heat helps to retain all the desirable product characteristics. Particle size and shape can be selected and controlled. The finished product is continuously removed and discharged from one point.

Compactly designed, these dryers require little headroom, keep initial and operating costs low. Complete accessibility makes between-batch cleaning easy and economical. Buflovak Spray Dryers offer a choice of high efficiency powder collecting systems best suited to your product.

Test your product in the Buflovak customer service laboratory

It's easy to check your product by running a test in the lab spray dryer. Here you can work with skilled engineers to obtain accurate performance data and actual samples of your spray dried product . . . see particle characteristics . . . examine process efficiency.

Contact Buflovak's research department for details on the facilities and services available to you.

BLAW-KNOX

BLAW-KNOX COMPANY
Buflovak Equipment Division
1551 Fillmore Avenue, Buffalo 11, N.Y.

IN MIXERS...tough buyers look at the bearings

Specifically, they look for oversize, heavy duty, high capacity bearings like the ones in this Philadelphia Mixer.

Their reasons are many. Oversize bearings mean the mixer will easily take maximum thrust and heavy unbalanced mixing loads.

Extra large bearings permit extra large output shafting. Shaft deflection is kept to an absolute minimum. Stuffing boxes need less maintenance. Mechanical seals last longer. You don't need steady bearings in tank bottoms.

Heavy duty inboard bearings give extra rigid support. Shaft run-out is minimized. Spiral gears run more smoothly . . . have longer life.

Oversize thrust bearings mean you can use standard Philadelphia Mixers for high pressure, closed tank applications.

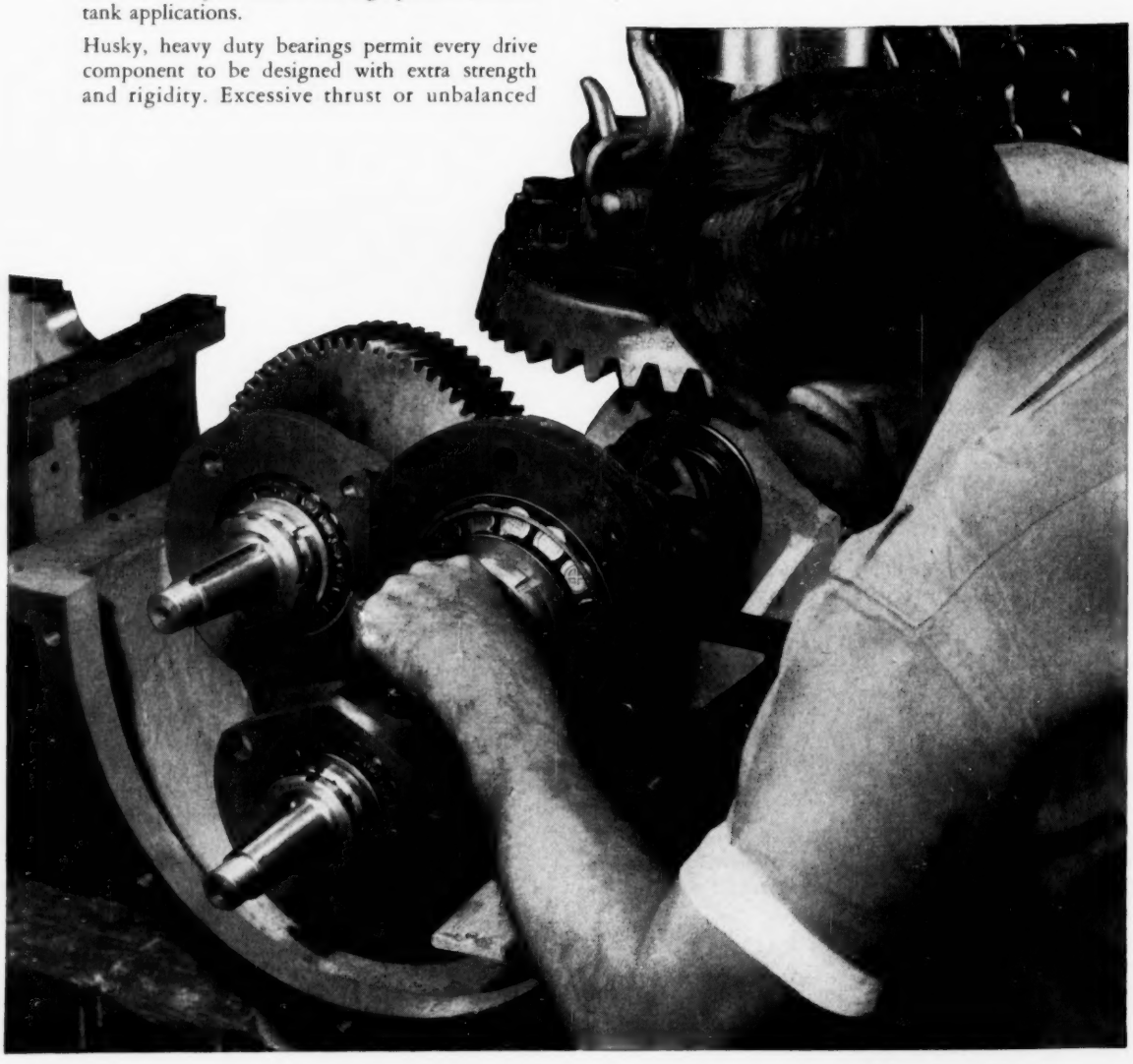
Husky, heavy duty bearings permit every drive component to be designed with extra strength and rigidity. Excessive thrust or unbalanced impeller loads simply can't cause shaft deflections which might damage the gearing.

Tough buyers look at the price too. And, you'll pay no premium for a Philadelphia Mixer. We are the only manufacturer that designs and builds the whole mixer. We control production and costs. We can *afford* to give you more mixer per dollar.

Write for Catalog A-27. It contains all the information needed for you to select your own Philadelphia Mixer. Philadelphia Gear Works, Erie Ave. and G Street, Philadelphia 34, Pa.

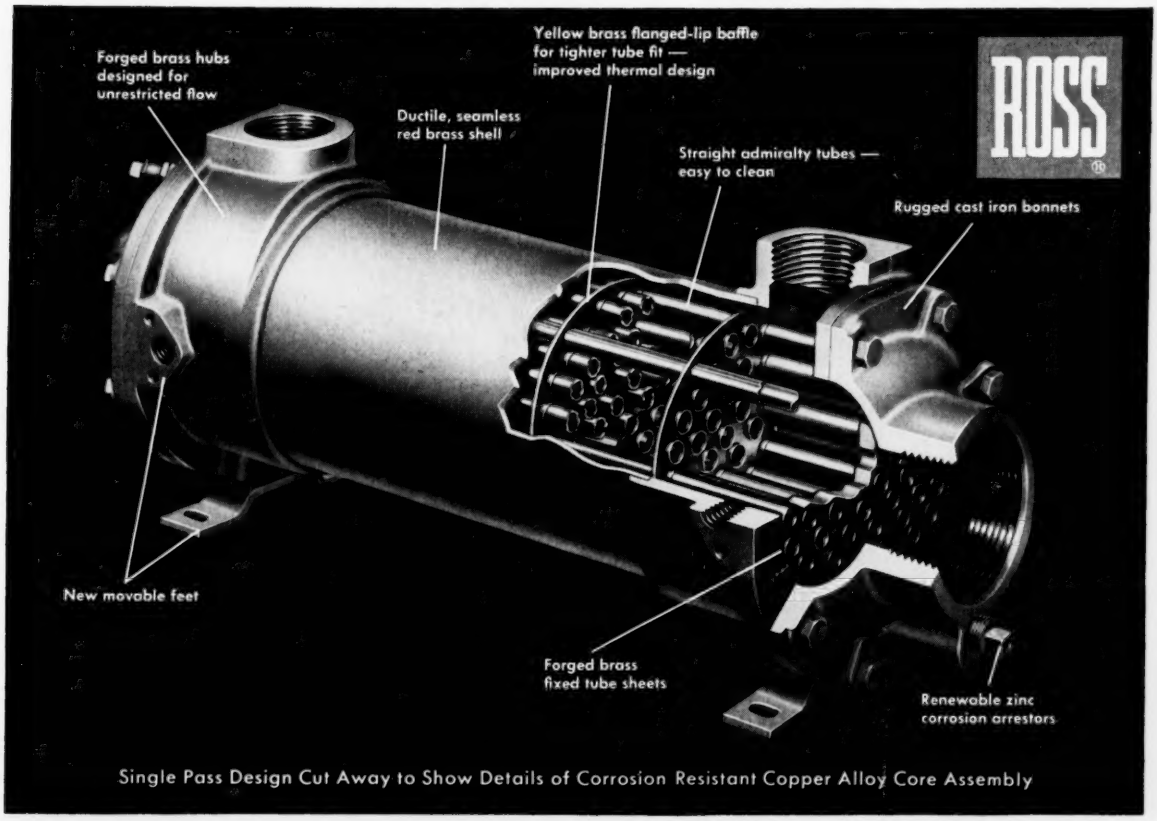
philadelphia mixers

Offices in Principal Cities



LOOK AT THE LEADER'S LATEST . . .

'58 design of a famous line . . . Ross BCF Exchangers


Forged brass hubs designed for unrestricted flow
Yellow brass flanged-lip baffle for tighter tube fit — improved thermal design
ROSS
Ductile, seamless red brass shell
Straight admiralty tubes — easy to clean
Rugged cast iron bonnets
New movable feet
Forged brass fixed tube sheets
Renewable zinc corrosion arrestors

Single Pass Design Cut Away to Show Details of Corrosion Resistant Copper Alloy Core Assembly

LOOK AT THE LIST . . . new design features, new sizes, new capacities, new mountings, new materials . . . *new low prices!* In 1958 the leader and originator of small, compact, fully standardized exchangers takes another step forward.

The Ross Heat Exchanger Division of American-Standard originated the whole BCF idea 14 years ago. Before then, pre-engineered design, mass produced parts and stocked assemblies were untried for a unit of this type. Designers and users of original equipment were quick to adopt the BCF as standard. Today, on a larger scale than ever, it is cooling lube oil, jacket water, hydraulic and other fluids for a wide variety of industries.

But, even with such success, the BCF has never been permitted to stand still. Ross has persisted in making constant design refinements and performance improvements . . . *1958 is typical: New* baffles with flanged lip at each tube hole and around outer edge for tighter fit and improved thermal characteristics. *New* stamped steel feet, movable in three positions around hubs for easy, more adaptable mounting. *New* sizes and capacities . . . 46 models . . . one, two or four pass designs . . giving greater selection than ever before.

Look at the leader's latest. Send in the coupon below for the new Ross Bulletin . . . an up-to-date run down on the 1958 Ross Type BCF Exchanger.

Mail this coupon for new Ross Bulletin

To: **American-Standard,** CE
Ross Heat Exchanger Division
Buffalo 5, N. Y.

Please send, without obligation, your new Bulletin 1.1K6 describing the 1958 Ross Type BCF Heat Exchanger.

NAME _____

TITLE _____

COMPANY _____

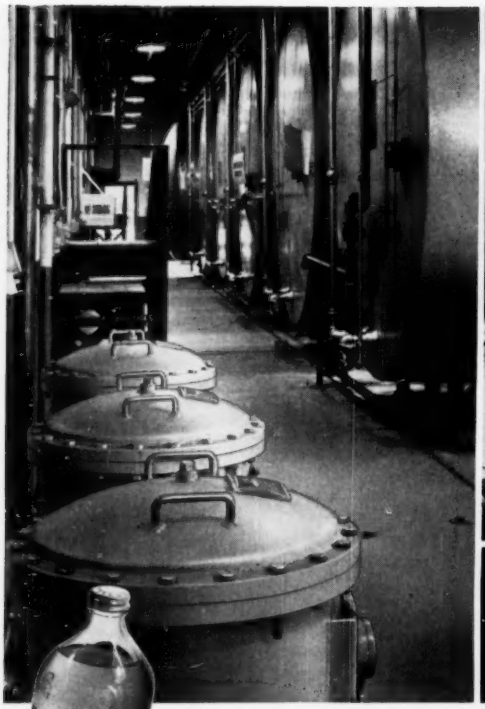
ADDRESS _____

CITY _____ ZONE _____ STATE _____

AMERICAN-Standard PRODUCTS

AMERICAN-Standard

ROSS HEAT EXCHANGER DIVISION



(Left) Fulflo Filters, with multiple Honeycomb Filter Tubes, remove micro-contaminants from raw process water used in the manufacture of LESTOIL, all-purpose detergent. Two primary filters (one stand-by) are in line, with one secondary filter in continuous operation.

(Above) LESTOIL receives final polishing to micro-clarity before being sealed in containers. Multi-tube Fulflo Filter is also used in this operation.

From Raw Materials . . . To Finished Product LESTOIL Achieves Sparkling Micro-Clarity with *Fulflo Filters*

If anyone knows the meaning of "cleanliness", it's Adell Chemical Company of Holyoke, Massachusetts. They manufacture LESTOIL — "the all-purpose detergent for household cleaning". And they assure micro-clarity of their own product with Fulflo Filters.

In addition to providing sparkling sales appeal for LESTOIL, Fulflo Filters achieve substantial savings through reduced down-time and improved product quality. Since using Fulflo Filters, Adell has eliminated all impurities in their finished product.

Fulflo Filters, with genuine Honeycomb Filter Tubes, provide any desired degree of micro-clarity for all types of industrial fluids: liquid chemicals; pharmaceuticals; water; oils; liquid fuels; compressed air, CO_2 and other gases. They give true depth filtration, at minimum pressure drop, for high or low flow rate, pressure, *p*H, temperature and viscosity. Complete engineering facilities are at your service.

Write for new catalog to Department CE

COMMERCIAL FILTERS CORPORATION
MELROSE 76, MASSACHUSETTS
PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

MICRO-CLARITY AT MINIMUM COST

Fulflo FILTERS — *with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.*

CFC FILTERS — *Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.*

Industry Standard for Lower Maintenance Costs

LQ600®

Here's Why: Long accepted valve maintenance costs are a thing of the past in thousands of plants where LQ600's have been installed . . . even in the most severe services where previous valves required repair or replacement after as little as two weeks on the line.

These outstanding savings are made possible by seats and discs of Brinalloy®, a patented Lunkenheimer alloy that is more resistant to wear and corrosion than 500 Brinell Stainless or 1000 Brinell Case-Hardened Stainless Steel.

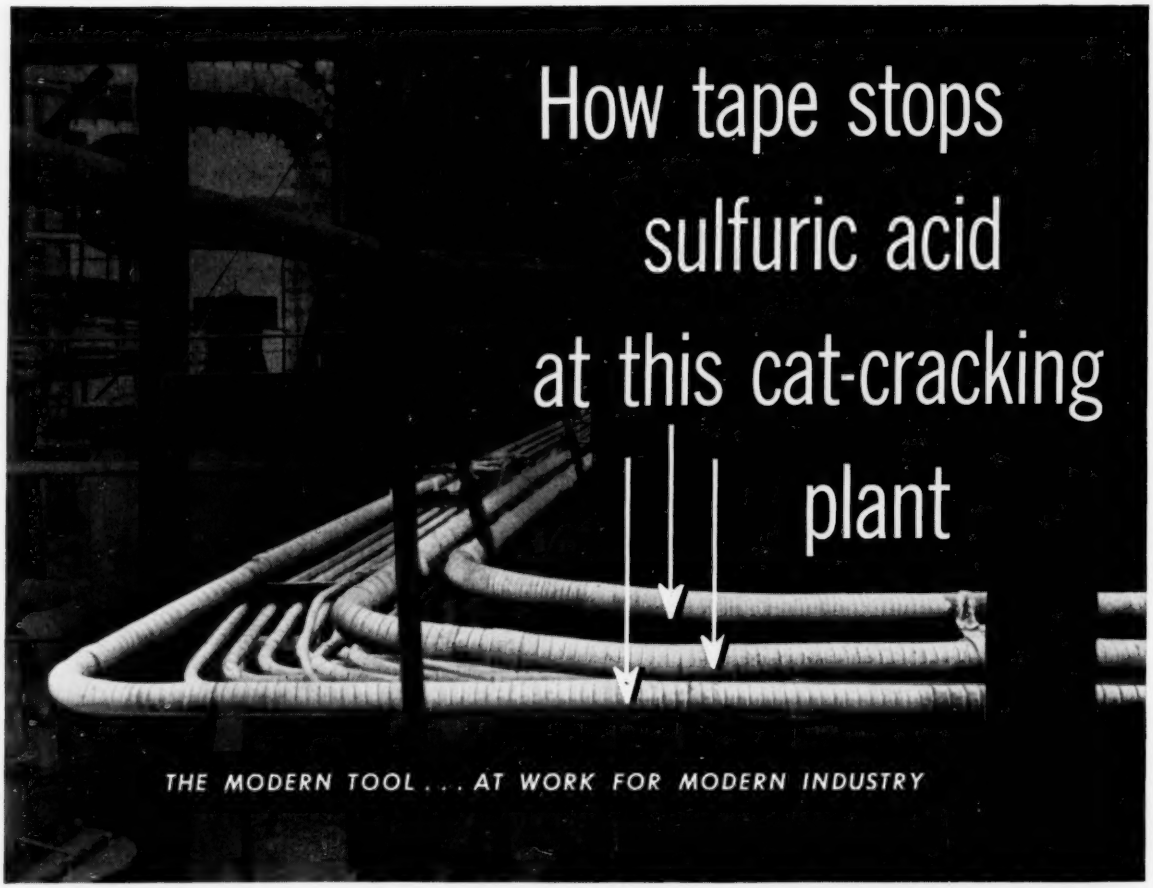
Add to this the Lunkenheimer exclusive silicon-bronze Stemalloy®, the most durable stem material ever put into a valve, and you have two important reasons why LQ600's have established new low-maintenance standards everywhere they are installed.

For an actual comparison test, call the Lunkenheimer Distributor in your area. He is an expert on valve maintenance costs and will be glad to demonstrate the maintenance-saving benefits you receive when you install LQ600's . . . or write The Lunkenheimer Company, Cincinnati 14, Ohio

LUNKENHEIMER QUALITY

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES



FIVE YEARS UNDER THESE HIGHLY CORROSIVE CONDITIONS PROVES THAT POLYKEN PROTECTION WORKS . . . *TO TRIM COSTS*

Look in on one of the world's largest fluid catalytic cracking units. A maze of conduit and pipe exposed to an extremely corrosive sulfuric acid atmosphere.

Formerly, these structures had to be painted every three or four months. Maintenance costs were excessive. Then, five years ago, they were wrapped with Polyken Protective Tape Coating. They have needed practically no attention since.

INERT POLYETHYLENE

The reason is that Polyken takes amazingly inert polyethylene and makes it into a tape coating with all these properties.

- **tough and elastic**
- **unplasticized, non-drying film**
- **doubly thick adhesive to seal all voids**
- **far higher adhesion for a true bond to pipe surface**
- **lower water vapor transmission rate**
- **higher electrical insulation resistance**
- **better cold weather handling and durability**

Check the savings. Contact the Polyken distributor in your area.

Atlanta, Georgia: Steele & Associates, Inc.
Chicago, Ill: Sales Engineering, Inc.
Cincinnati, Ohio: Hare Equipment
Cleveland, Ohio: The Harco Corp.
Des Moines, Ia.: The Donald Corp.
Fort Worth, Texas: Plastic Engineering & Sales Corp.
Harvey, La.: Allen Cathodic Protection Co.
Houston, Texas: Cathodic Protection Service.
Kansas City, Mo.: Industrial Coating's Engineering Co.
Long Beach, Calif.: Barnes & Delaney
Minneapolis, Minn.: Simcoe Equipment Co.
Oakland, Calif.: Bison Co.
Philadelphia, Pa.: Harold N. Davis Co.
Pittsburgh, Pa.: Royston Laboratories, Inc.
Plainfield, New Jersey: Stuart Steel Protection Corp.
St. Louis, Mo.: Shutt Process Equipment Corp.
San Francisco, Calif.: Aetna Sales Co.
Seattle, Wash.: Farwest Corrosion Control Corp.
Seattle, Wash.: Pacific Water Works Supply Co.
Tulsa, Okla.: William Cluff Corp.

Polyken®

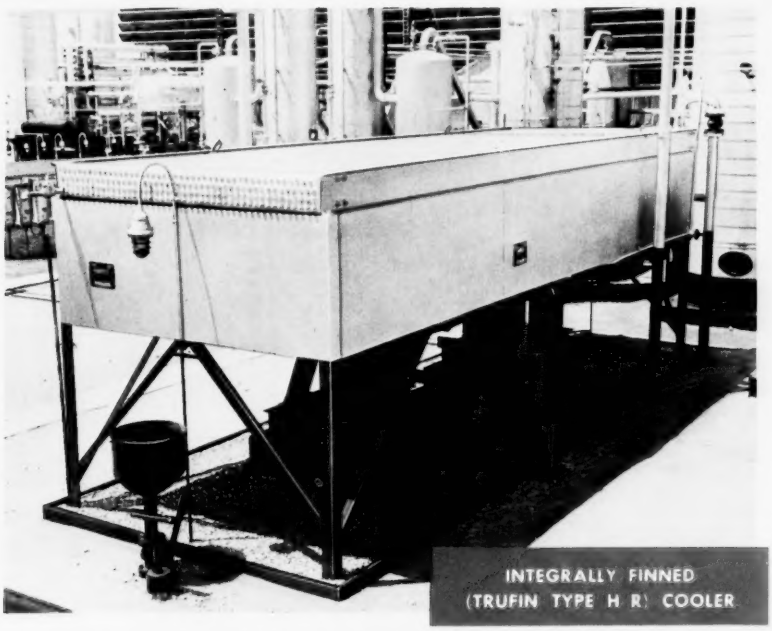
Experienced in modern PROTECTIVE COATING

THE KENDALL COMPANY
Polyken Sales Division

WOLVERINE
TUBE
Items of Interest to the Processing Industry

PUBLISHED BY WOLVERINE TUBE

AIR COOLER TUBED WITH WOLVERINE TRUFIN® TYPE H/R



INTEGRALLY FINNED (TRUFIN TYPE H R) COOLER

BY ERNEST DODD

Of major interest to the processing industry—particularly in those areas where water is scarce or costly—is the operating record of an air cooled Monoethanolamine heat exchanger currently on stream in a West Texas gas plant.

The unit is tubed with Wolverine Trufin Type H/R high-finned aluminum condenser tube and was fabricated by the **Happy Company** of Tulsa, Oklahoma.

Since going on stream in May, 1954, it has operated continuously, effectively and economically in handling a heat load of 4,000,000 btu's per hour in cooling 200 gpm of 8% MEA solution from 160° F. to 120° F. with 100° air at 3000 feet elevation. Coil design pressure is 150 psig at 250° F. The coil is 6-pass and has four rows of 1″ O.D. x 24′ long aluminum high-finned tubes.

Wolverine Trufin Type H/R is ideally suited for air-cooled operations and proved, in this case, to be the most economical tube in both capital investment and maintenance. Type H/R's ratio of outside to inside surface area is approximately 8:1. It is available in a wide range of sizes in both copper and aluminum.

Because its integral fins are squeezed directly from the tube wall, they have a life expectancy equal to that of the tube —they can never shake loose because of vibration, thermal shock or pressure variations.

Listed on page 4 of this insert are the names, addresses and telephone numbers of Wolverine's highly skilled Technical Sales Representatives. If you want more information about Wolverine Trufin — or if you have a problem concerning the use of finned tube in heat transfer applications just call the one nearest you. There is no obligation.

Wolverine Pioneered Integrally Finned Tube

In recent years, increased heat transfer effectiveness through the use of extended surface tubing has become a well established principle and accomplishment.

A large share of the credit for this is due to Wolverine Tube because of its pioneering in the field of integrally finned condenser tube.

In manufacturing this type of tubing, Wolverine extrudes the fins spirally from the tube wall. This extrusion process produces a smooth fin minus sharp angles or crevices. The fins are actually part of the tube wall and are unaffected by excessive vibration or other hazards.

Wolverine Trufin is available in a wide range of sizes and alloys in copper, aluminum and electric-welded steel. Its various types are S/T (for shell and tube condensers), H/A, H/R, and L/C (for air cooled use primarily) and Type I/L (a high finned exterior tube with longitudinal interior fins).

TRUFIN CATALOG AVAILABLE—FREE

Wolverine's Trufin Catalog carries complete descriptions of each type of Trufin condenser tube. In addition to sizes, metals and alloys the catalog also describes the various applications where integral finned tube can be used to full advantage. This book is a valuable source of finned tube information —should be in the reference file of every processing engineer. Write today for your free copy—there is no obligation.

interchangeable with plain condenser tube (Type S/T only)

easily fabricated—available in U-bends

one-piece construction

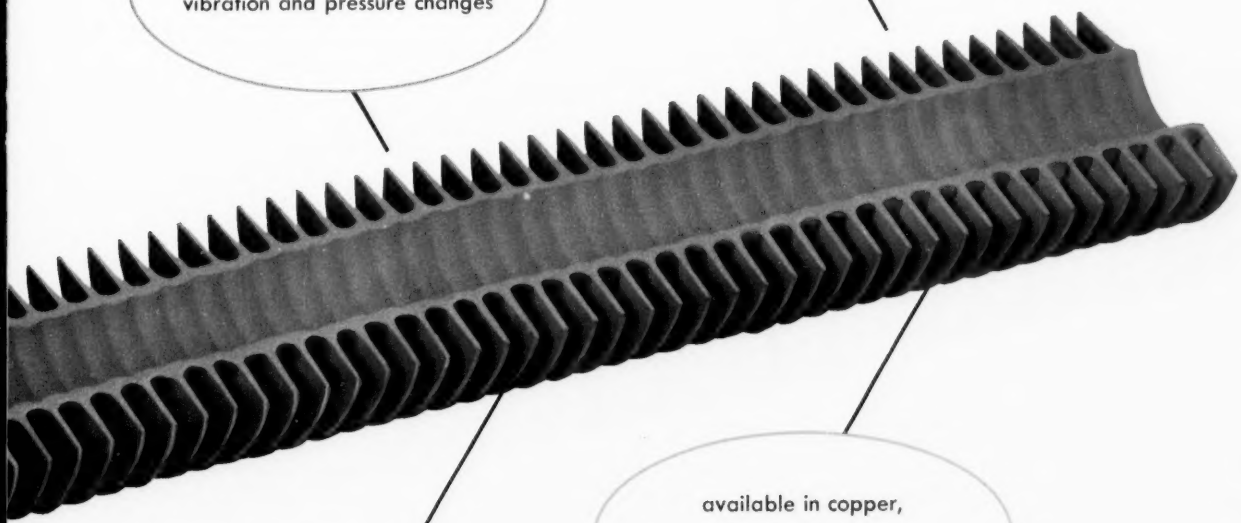
several types of end treatments available

high finned outside to inside surface ratios up to 8-1. (Types H/R, L/C, and I/L)

available with either high or low fins with a wide variety of fin spacings

smooth extruded fins eliminate sharp angles and crevices

fins stand up under thermal shock, vibration and pressure changes



available in copper, copper-base alloys, aluminum and electric-welded steel

more BTU's per foot of tube

THIS IS WOLVERINE TRUFIN!

Look at the advantages—see for yourself what Trufin can do for you. Specify it for new installations and for retubing at turn-around time. You'll do a bigger job . . . boost production . . . save money, too!

Expert Guidance Always Available

These are Wolverine's Technical Sales Representatives—fully qualified men who are ready to help you with your tubing problems.

M. A. WALLESZ
P. O. Box 569
Suite 408-410
National Bank Building
Evanston, Illinois
Phone in Evanston
DAvis 8-8616
Phone in Chicago
ROgers Park 4-7412

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8941 Schaefer Highway
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Phone—WEbster 1-0783

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148 Spear Street
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Liberty Trust Building
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Rittenhouse 6-1442

R. F. POWELL
2 North York Street
Corner of Commerce
Houston 3, Texas
CApitol 2-8191

D. E. WESSELS
2 North York Street
Corner of Commerce
Houston 3, Texas
CApitol 2-8191

ON STREAM TIME UPPED WITH TRUFIN ON JOB

Designers — when working for the first time with integrally finned condenser tube—sometimes assume that finned tubing should be used only in a clean service.

Nothing could be farther from the truth. The compilation of actual operating data and the results of extensive pilot plant research are proving, instead, that integrally finned Wolverine Trufin actually gives better service than plain tube over longer periods of time.

Comparison tests have shown that when Trufin fouls, the build-up of the scale follows the profile of the fins and tube instead of preferring the valleys between the fins. Thus because Trufin does not present a flat, unbroken surface there is a strong tendency for the scale to fall away which prevents the build-up of an impervious layer.

TRUFIN HELPS CUT STRUCTURAL WEIGHT

Design of smaller heat exchangers and condensers is now possible because of Wolverine Trufin. This integrally finned condenser tube transfers more BTU's per foot of tube — thus permitting more heat transfer surface to be packed into a given area.

Where overhead units are used, the compact, powerful Trufin units require less structural support—an important feature which contributes substantially to lower costs.

Write for FREE Book

Actual installations where Wolverine Trufin is being used throughout the processing industries are described in "Wolverine Trufin Process Flowsheet Book".

In addition, this handy book contains information about Wolverine Tube, its facilities and the specialized services it offers its customers.

Processing engineers—both experienced veterans and those just starting their careers—will want to add the Trufin Process Flowsheets Book to their reference files. Write for your copy today.

BUY WOLVERINE TUBE—IT'S MADE IN AMERICA

CALUMET & HECLA, INC.
CALUMET DIVISION
URANIUM DIVISION
GOODMAN LUMBER DIVISION
WOLVERINE TUBE DIVISION

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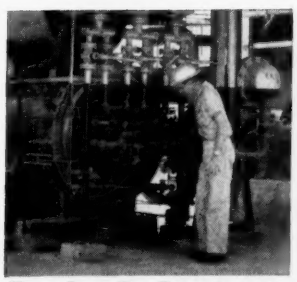
17232 Southfield Road
Allen Park, Michigan
Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES
EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, NEW YORK
Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario

Interior of Kemp Generator in action

Burned up by inert gas costs?

Come to Kemp



Kemp Inert Gas Generator cuts inert cost 90% in Upjohn's Kalamazoo plant. Purity of gas is constant and exact qualitative analysis is maintained up to full generator capacity. Kemp generators play important roles in organic and inorganic operations throughout the country.

Kemp Inert Gas Generators end the trouble and expense of bottled gas, provide a highly flexible source of supply at a fraction of the cost. With Kemp generators in your operation, you can make liberal use of inerts . . . apply them to the improvement of many other operations. There are Kemp units to manufacture inerts in any quantity, for any application.

Kemp equipment is dependable. You get rugged design, simplicity of operation, and almost complete elimination of maintenance. Each unit is completely protected with safety devices. The heart of the generator is the famous Kemp Carburetor, for precise control of inert quality, regardless of system demands.

Kemp produced inerts belong in your plant . . . for blanketing, purging, and protective uses . . . agitation of batches during cooking . . . conveying combustibles and controlling reactions.

For new installations or modernization programs, call in your Kemp Representative. Or write us for Bulletin I-10. The C. M. Kemp Mfg. Co., 405 E. Oliver St., Baltimore 2, Md.

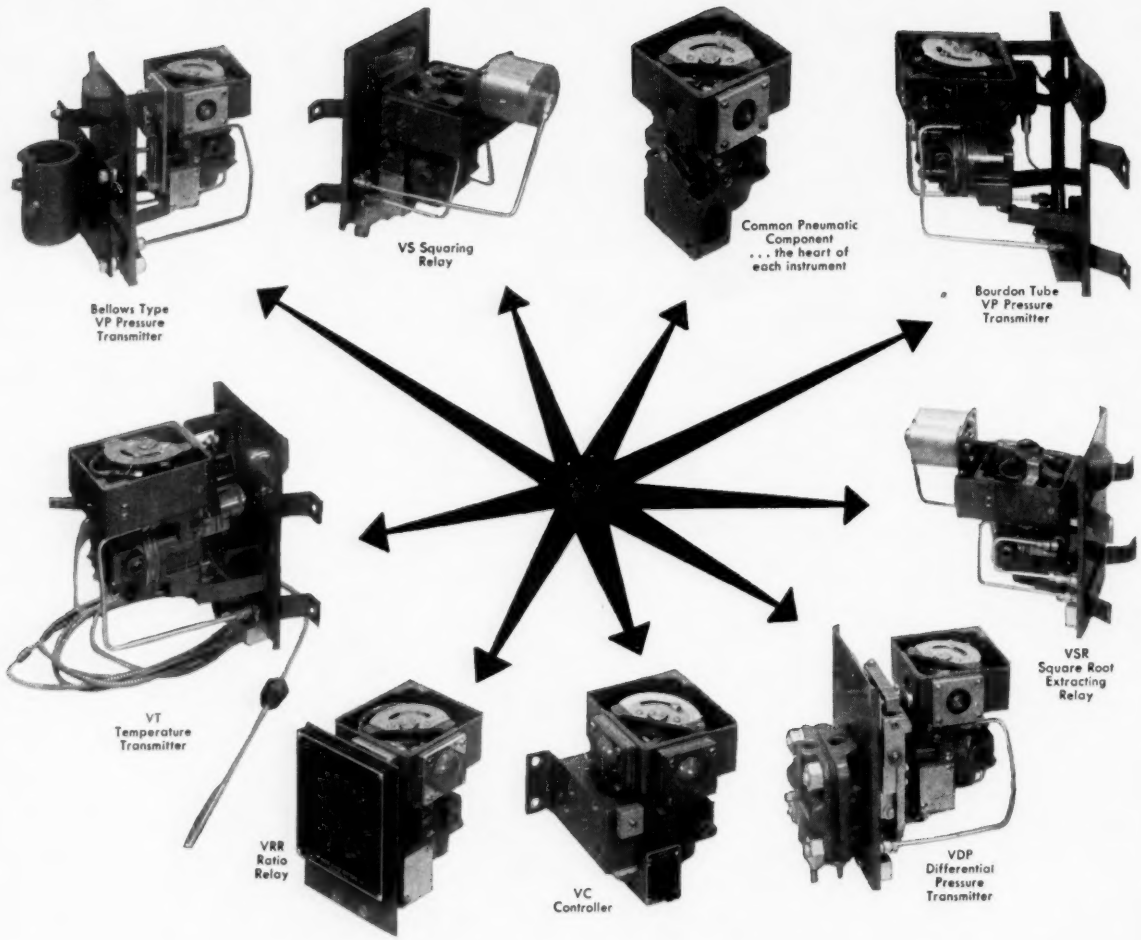
Kemp Convection Dryers

Kemp Immersion Melting Pots

KEMP OF BALTIMORE

Kemp Industrial Carburetors

Kemp Oriad Dryers



It's YOUR move—in ANY direction—with

Republic's New Family of Null-Balance-Vector Instruments

Here are only a few of Republic's new line of pneumatic instruments. Their sensitive, extremely accurate components are both compact and interchangeable. Their versatility is phenomenal. Consider: the Vector Series components in *each* of these instruments can be moved and *recombined in infinite variety*. They form temperature transmitters with 10-to-1 range adjustment . . . pressure transmitters of ±0.5% accuracy . . . differential pressure transmitters with 20-to-1 range adjustment . . . controllers which feature repeatable re-set rate, less than 0.05% dead band and proportional band adjustment from 2 to 500%.

The span of each instrument can be varied at will; only a screwdriver and a reference are necessary—zero need not be re-set. Republic's Null-Balance-Vector design permits full-range operation with virtually no parts motion—and virtually no wear.

This new family of pneumatic instruments was developed in a coordinated program to use the greatest possible number of common components. Because these can be interchanged, even among instruments performing entirely different functions, training and spare parts problems are greatly simplified. The versatility of Republic components is at once a challenge and an answer to imaginative engineers. A few minutes of discussion on this subject could be well worthwhile . . . and a call to your nearest Republic Sales Office will set it up at your convenience.

For detailed, descriptive folios write

REPUBLIC FLOW METERS CO.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
2240 DIVERSEY PARKWAY CHICAGO 47, ILLINOIS
In Canada: Republic Flow Meters Canada, Ltd.—Toronto
Manufacturers of electronic and pneumatic instrument and control systems for utility, process and industrial applications.

Lowest Prices in the Industry for Highest-Quality OVENS

AMINCO'S famous forced-convection ovens solve the big problems in today's research and industrial laboratories; . . . they eliminate hot and cold pockets; they provide precise temperature control; and minimize power consumption.

The many styles and sizes listed at right employ motor-driven blowers which produce movement of a large volume of heated air, horizontally across the work chamber. This, together with the circular arrangement of the heaters, results in uniform distribution throughout the entire work chamber.

All ovens listed are provided with positive locking latches, adjustable perforated shelves, and a removable control panel.

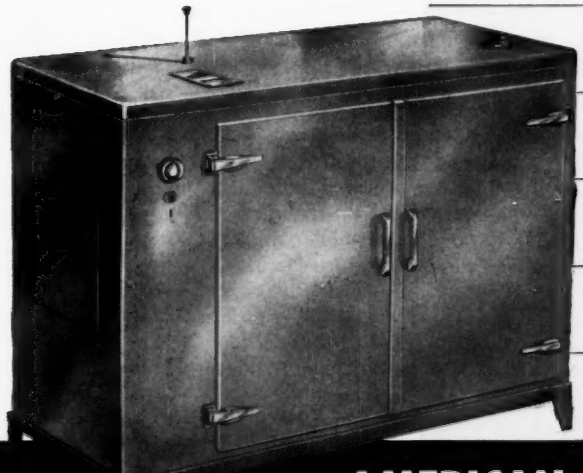
On special order, pyrex inner doors, explosion-proof fittings, and blow-out safety panels can be supplied.

Complete information furnished upon request, in new bulletin 37-37-C

Immediate delivery from Stock!

Compare these prices with any other top-quality ovens—the savings per cubic foot are substantial!

Description	Price per Cu. Ft.	Total Price
4-3510 Oven, with cold-rolled steel interior and Linco-flek exterior. 115 volts; size: 19 x 19 x 19 in.	$134.61	$ 525
4-3521 Oven, with cold-rolled steel interior and Linco-flek exterior. 230 volts; size: 37 x 19 x 25 in.	71.80	718
4-3540 Oven, with Linco-flek exterior, and stainless steel interior. 230 volts; size: 19 x 19 x 19 in.	161.53	630
4-3541 Oven, with Linco-flek and stainless steel interior. 230 volts; size: 37 x 19 x 25 in.	87.30	873
4-3560 Oven, with stainless steel interior and exterior. 230 volts; size: 19 x 19 x 19 in.	211.02	823
4-3561 Oven, with stainless steel interior and exterior. 230 volts; size: 37 x 19 x 25 in.	114.80	1148
4-3516 Oven, with Linco-flek exterior and cold-rolled interior. 230 volts; size: 19 x 19 x 19 in.	134.61	525
4-3522 Oven, with Linco-flek exterior and cold-rolled interior. 230 volts; size: 37 x 25 x 37 in.	42.27	837
4-3530 Oven, with Linco-flek exterior and stainless steel interior. 115 volts; size: 19 x 19 x 19 in.	161.53	630
4-3542 Oven, with Linco-flek exterior and stainless steel interior. 230 volts; size: 37 x 25 x 37 in.	54.50	1079
4-3550 Oven, with stainless steel exterior and interior; 115 volts; size: 19 x 19 x 19 in.	211.02	823
4-3562 Oven, with stainless steel exterior and interior; 230 volts; size: 37 x 25 x 37 in.	64.39	1275



AMERICAN INSTRUMENT CO., INC.

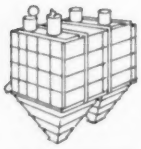
8030 GEORGIA AVENUE, SILVER SPRING, MARYLAND

Buell Combination Cyclone-Precipitator installation at cement plant.

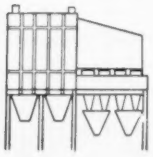
"Paid for itself!"

In nearly all cases, Buell dust or fume collection systems pay for themselves in just a few years. Buell "SF" Electric Precipitators provide extra collection efficiency *and* lower maintenance costs year after year, thanks to features like the exclusive high-emission, self-tensioning Spiral-ectrodes and unique Continuous Cycle Rapping. For specific information about dust collection efficiency and all three Buell systems, write for a copy of the booklet, "The Collection and Recovery of Industrial Dusts." Dept. 12-B Buell Engineering Company, Inc., 123 William Street, New York 38, N. Y.

BUELL CYCLONE



"SF" ELECTRIC PRECIPITATOR

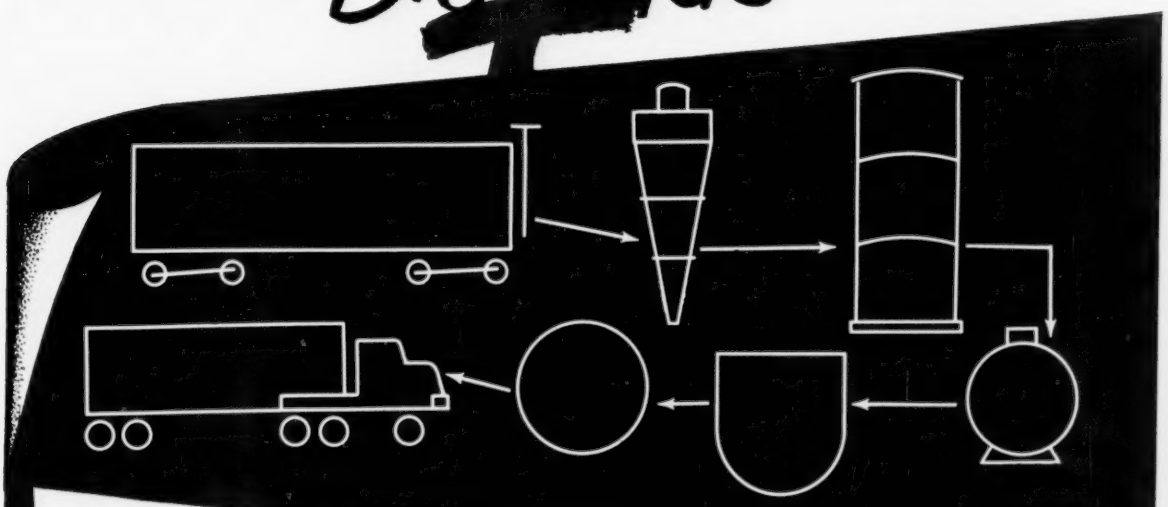


PRECIPITATOR-CYCLONE COMBINATION

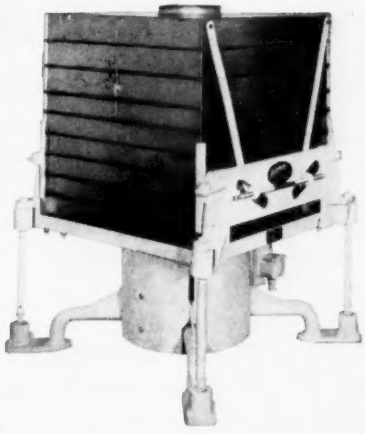
buell®

Experts at delivering Extra Efficiency in **DUST COLLECTION SYSTEMS**

Sprout-Waldron's *Big Plus* **can save you money**



...in size classification equipment



You'll find at Sprout-Waldron one of the most complete lines of equipment for classifying, grading, and cleaning.

Outstanding in this line are the famous **Richmond/Sprout-Waldron Gyro-Whip** Sifters, shown here. They provide a modern sifting method that maintains utmost sanitation . . . reduces maintenance and cleaning . . . and saves floor space. Sieves can be of stainless steel, wood, or wood lined with stainless. Available are models with single stacks of sieves . . . models with sieve stacks suspended from overhead . . . models mounted on pedestals . . . and laboratory models.

Also included in the Sprout-Waldron line are gyro shakers, stream splitters, dust collectors, reels, shaking and gyrating screens, and air separators.

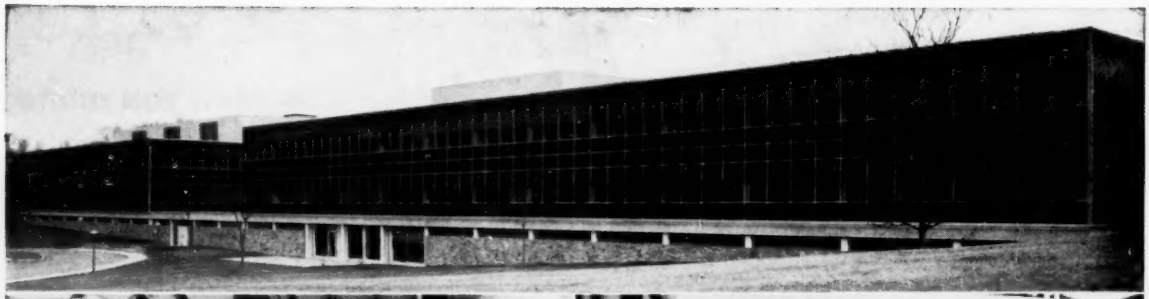
With each Sprout-Waldron machine, you receive a **BIG PLUS** at no extra cost. This provides you with expert, unbiased engineering counsel and guidance on installations and applications . . . plus an ability to "adaptioneer" equipment to meet your individual requirements . . . plus 100% reliability. Sprout-Waldron's **BIG PLUS** can save you money on first costs and reduce your operating expenses.

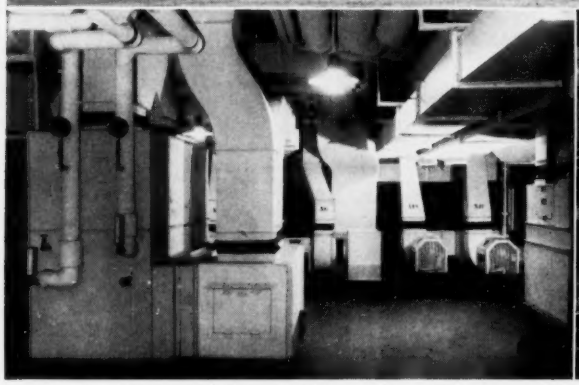
Let Sprout-Waldron analyze your size classification problem and recommend an unbiased solution without obligation. Write for details.

SPROUT-WALDRON

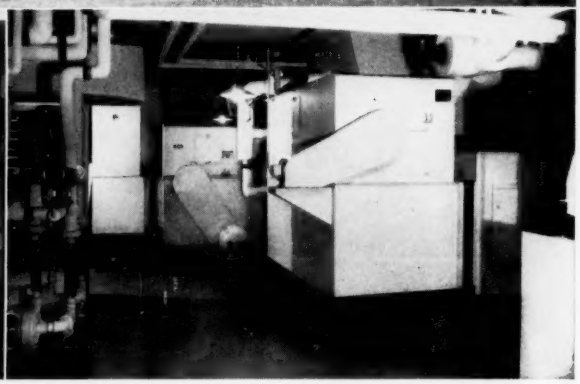
Manufacturing Engineers Since 1866

15 LOGAN STREET • MUNCY, PA.





On left, Clarage Multitherm supplying conditioned air to the electrophoresis balance room. Exhaust fans in background.



In foreground, Multitherm supplying make-up air exhausted by laboratory hoods.

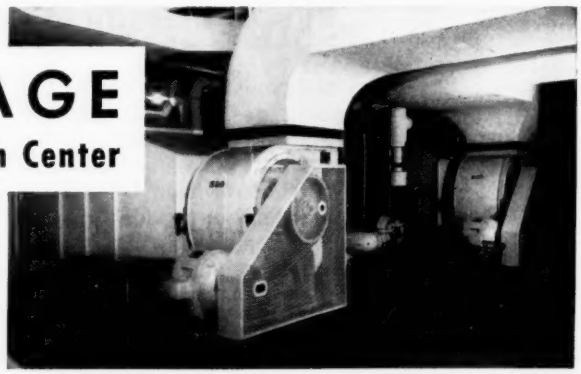
AIR via CLARAGE

in Wyeth's new Office and Research Center

One of the most modern of its type, this virtually window-lined building at Radnor, Pennsylvania serves Wyeth Laboratories, Inc.

As for so many other notable installations, Clarage equipment was chosen for the air handling and conditioning — Clarage Type NH and Type HV system fans, Multitherm air conditioning units, Ready Unit ventilating sets.

Clarage equipment has a long-standing reputation for doing the job quietly, economically, and dependably in buildings of all types, all sizes. Make sure *your* investment in air handling and conditioning is a profitable one by choosing Clarage quality.



Type HV fans supplying air to dining room and office interior.

ARCHITECT:
Skidmore, Owings & Merrill — New York City.

ENGINEER:
Seelye, Stevenson, Value & Knecht—New York City.

GENERAL CONTRACTOR:
George A. Fuller Co. — New York City.

MECHANICAL CONTRACTOR:
W. M. Anderson Co. — Philadelphia, Pa.

CLARAGE FAN COMPANY Kalamazoo, Mich.

. . . dependable equipment for making air your servant

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

IF YOU ARE USING A MAGNESIUM MATERIAL...

...you can improve operating efficiencies, cut costs and increase product quality with...

HIGH PURITY 99.0+% MAGNESIUM OXIDE

International MgO may offer you unexpected advantages as a replacement for other material or for a new application. It has unusual versatility in performance characteristics—and is produced in the highest purities ever available in carload quantities and in the low price range. Our research staff offers you technical assistance on end use problems and in the application of MgO to your production processes.

price range

International MgO prices range from $110 to $250 per ton, F.O.B. Carlsbad, depending on grade, packaging and quantity.

INTERNATIONAL MgO HAS DEMONSTRATED ITS SUPERIORITIES FOR THESE AND OTHER USES

As an alkali precipitant.

As a compounding agent in rubber formulations.

As a furnace feed for special fused refractories.

In the manufacture of high purity magnesium compounds.

For blending with other magnesias.

INTERNATIONAL MINERALS (International Minerals & Chemicals) **& CHEMICAL CORPORATION**

POTASH DIVISION .... 20 N. Wacker Drive, Chicago 6

485 LEXINGTON AVE., NEW YORK 17 • MIDLAND, TEXAS • FULTON NATIONAL BANK BLDG., ATLANTA, GA.

physical specifications
(Color . . . White)

PELLETS:	Approx. 1/8" x 3/8", plus 12 mesh Bulk density: 60 lb. cu. ft.
GRANULAR:	All minus 12 mesh Bulk density: 70 lb. cu. ft.
POWDERED:	100% minus 200 mesh 90% + minus 325 mesh Bulk density: 80 lb. cu. ft.

INTERNATIONAL MINERALS & CHEMICAL CORPORATION
20 North Wacker Drive, Chicago 6

☐ Please send me samples of MgO in ..... form
(pellet – granular – powdered)

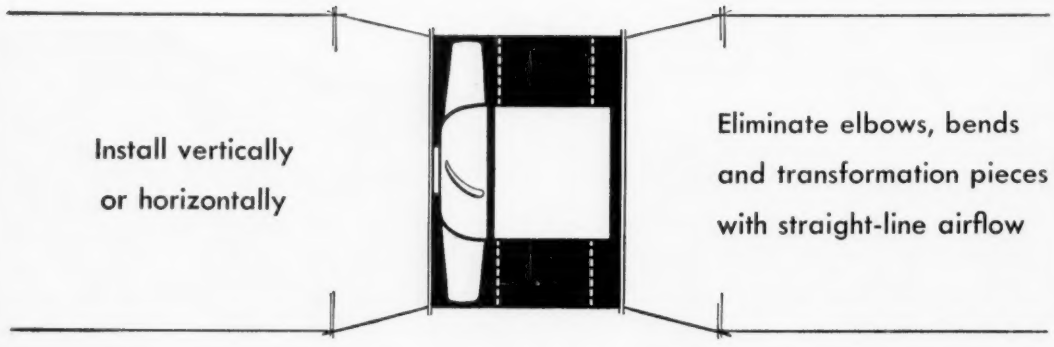
☐ Please send Magnesium Oxide Brochure
My field of interest for MgO is .....

Name .....

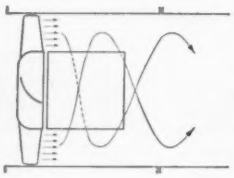
Firm .....

Address .....

City ..... State .....

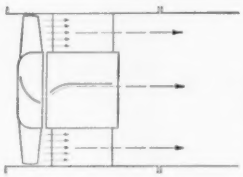


Large-diameter hub and die-formed blades insure uniform air velocity from hub to tip.



TUBEAXIAL

Air discharge follows a spiral path, then straightens out a short distance from fan at moderate pressures.



VANEAXIAL

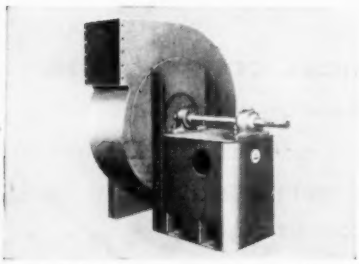
Air discharge is transformed into useful energy by directional guide vanes, increasing efficiency, pressure.

American Blower axial fans deliver the volume you need; fit the space you have!

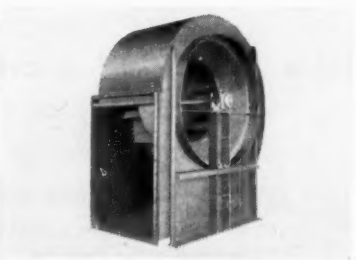
Whatever your air-moving problem – ventilating, heating, drying or processing – you'll find an economical solution in the complete line of precision-built American Blower fans. *Plus-value:* Rugged construction of every American Blower fan gives you extra years of low-cost service with minimum maintenance.

Seventy-three American Blower branch offices from coast to coast – are staffed by skilled sales engineers. Ask them to help you select the right equipment for *your* job. Call today! American-Standard, American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

It pays to standardize on American Blower fans for every duty!



Industrial Fans—three wheel-options

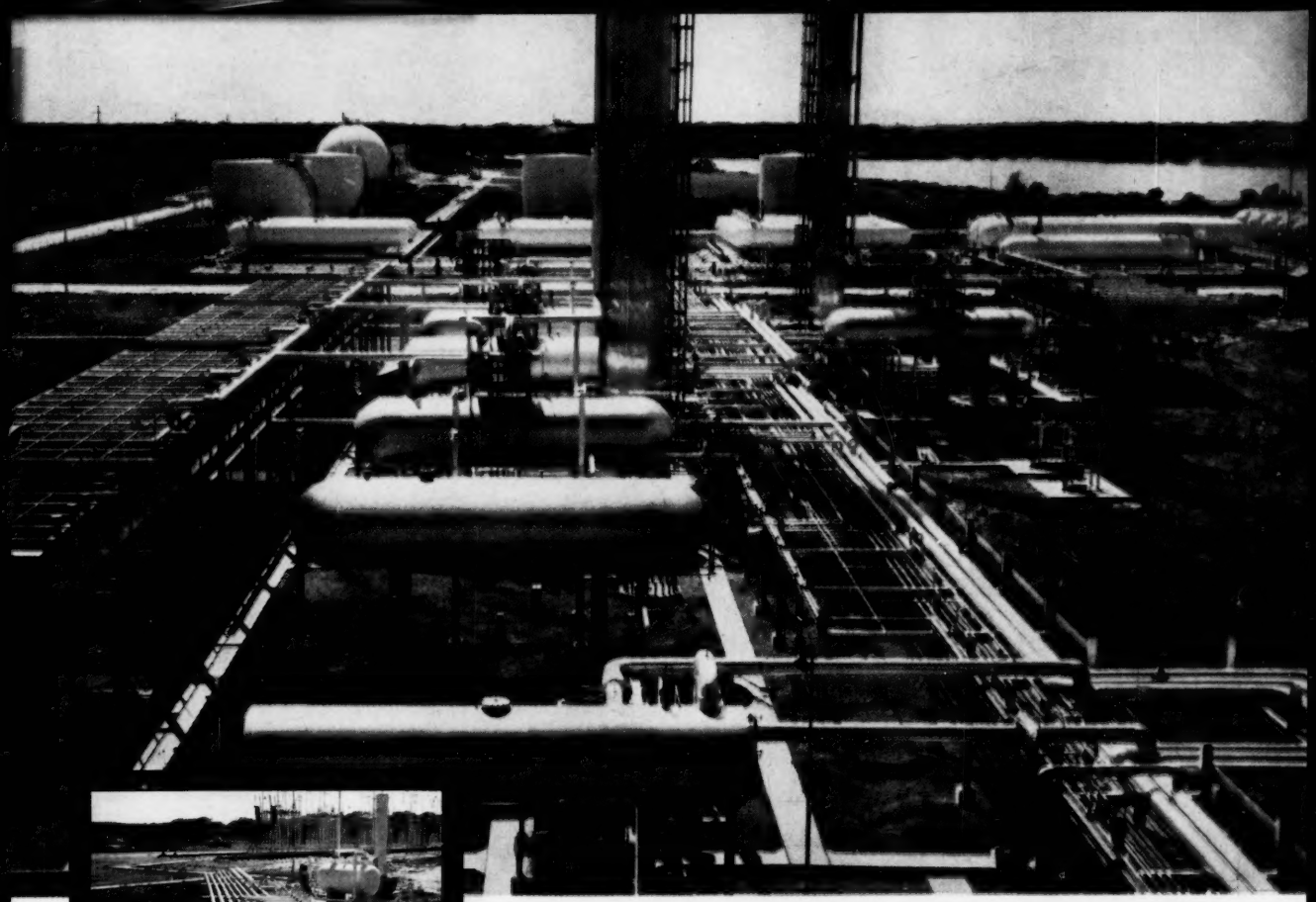


HS Fans—nonoverloading, minimum power

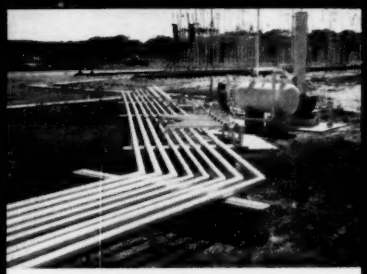
Sirocco Fans—low speed, quiet operation

AMERICAN-Standard

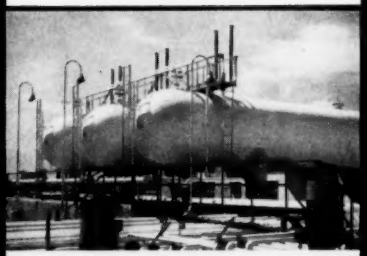
AMERICAN BLOWER DIVISION



Three-coat systems of Normal Copon self-cleaning white tank coating and three-coat systems of Normal Copon aluminum tank finish were used to protect this fractionating plant of The Bay Petroleum Corp. (a subsidiary of Tennessee Gas Transmission Co.).



Copon pipe coatings provide thicker films per coat for extra protection of seams, welds, sharp edges and other trouble spots.



Copon tank coatings remain tough and elastic when subjected to heat, high humidity and chemical fumes.

Tanks stay whiter, brighter... protected by Copon coatings

Coatings of Normal Copon provide superior protection for tanks, pipes, and miscellaneous plant equipment. They cling tenaciously to metal surfaces, withstand the expansion and contraction of metal, and provide longer-lasting film integrity to assure permanent corrosion protection. Expensive surface preparation is not required when Copon-protected tanks are repainted, and Copon Coatings have the slowest rate of erosion in the industry.

Copon®

FOR CORROSION CONTROL

For complete information on Copon, write on your company letterhead to the manufacturer located nearest your city.

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65 W. First South St., Salt Lake City 10, Utah.

WALTER N. BOYSEN CO.
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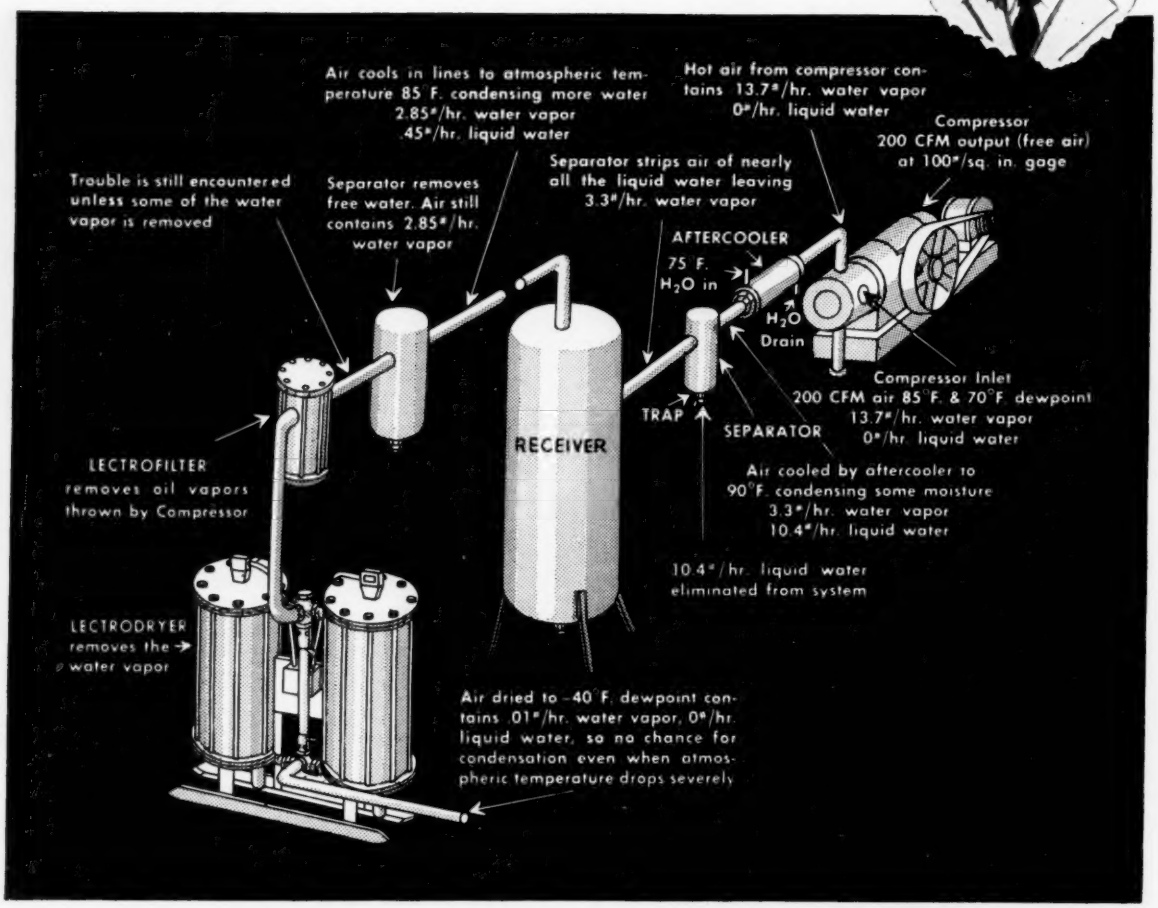
MULSYN PAINT & CHEMICALS
64-70 Hanover Street
Fitzroy, N. 6, Melbourne, Aust.

An instrument man tells why he uses a LECTRODRYER* on every control system


Air cools in lines to atmospheric temperature 85 F. condensing more water
2.85#/hr. water vapor
.45#/hr. liquid water
Hot air from compressor contains 13.7#/hr. water vapor
0#/hr. liquid water
Compressor
200 CFM output (free air)
at 100#/sq. in. gage
Trouble is still encountered unless some of the water vapor is removed
Separator removes free water. Air still contains 2.85#/hr. water vapor
Separator strips air of nearly all the liquid water leaving 3.3#/hr. water vapor
AFTERCOOLER
75 F.
H_2O in
H_2O Drain
Compressor Inlet
200 CFM air 85°F. & 70°F. dewpoint
13.7#/hr. water vapor
0#/hr. liquid water
TRAP
SEPARATOR
RECEIVER
LECTROFILTER
removes oil vapors thrown by Compressor
Air cooled by aftercooler to 90°F. condensing some moisture
3.3#/hr. water vapor
10.4#/hr. liquid water
10.4#/hr. liquid water eliminated from system
LECTRODRYER
removes the water vapor
Air dried to -40° F. dewpoint contains .01#/hr. water vapor, 0#/hr. liquid water, so no chance for condensation even when atmospheric temperature drops severely

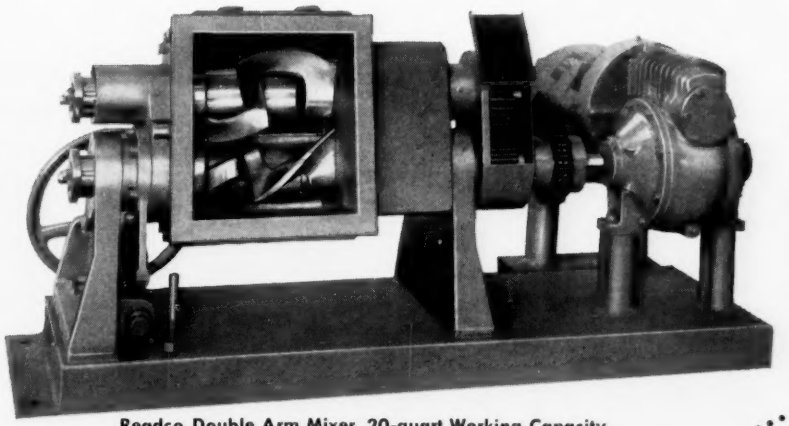
Aftercoolers, traps and separators catch only the free water in compressed air. Vaporous moisture gets out into the lines and condenses—a trouble-maker at instruments, valves and air motors.

Rust, mud and ice form and interfere with sensitive controls. But not on a system safeguarded by Lectrodryer equipment. The above chart tells you why.

Whether your controls call for large or small amounts of air, there are Lectrodryers in sizes to suit. Bulletin 223B describes them. For a copy, write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 303 32nd Street, Pittsburgh 30, Pennsylvania.

Lectrodryer

*REGISTERED TRADEMARK U. S. PAT. OFF.



Readco Double Arm Mixer, 20-quart Working Capacity

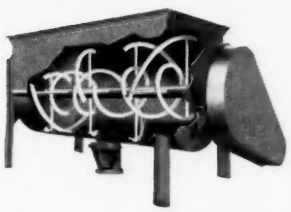
Predict production precisely with READCO Lab and Pilot Plant Mixers

READCO

Incorporating all the basic design features of larger production models, Readco Laboratory and Pilot Plant mixers enable you to make accurate forecasts for commercial processing.

Mixing bowls are accurately machined and fitted . . . have vacuum covers and temperature controlling jackets. Overlapping sigma mixing arms are held in constant close clearance, eliminate dead spots, prevent build-up of materials, aid temperature control. Easily interchangeable mixing arms adapt to various materials or processes.

Ruggedly built of Type 316 stainless steel, or any commercial alloy, Readco lab and pilot plant mixers will efficiently handle even heavy viscous material. They are available from stock in 1, 3, 6, 20 and 40-quart working capacities, with fixed or variable speed drives. For more information see Chemical Engineering Catalog, pages 1483-1490 . . . or write direct.



Readco Spiral Ribbon Mixers—Batch or Continuous. Standard sizes 1 to 500 cu. ft. working capacities.

Readco Vertical Mixers, planetary action, multiple speed, 12 to 175 qt. working capacities. (Model K-20 illustrated)

Whatever the mixing job . . . a READCO mixer!

READ STANDARD

York, Pennsylvania

A Division of Capitol Products Corporation

BUTADIENE CAPACITY INCREASED

365,000 Tons/yr in 1957

85% THRU ISOFLOW HEATERS

...and "Isoflows" in five new Butadiene plants are additionally supplying 1,000,000 lbs/hr of superheated steam up to 1400° F

Butadiene capacity is mushrooming to meet the rising demands of synthetic rubber and chemicals. Of the new butadiene plants put into operation during 1957, Petrochem Isoflow Furnaces have been installed in the 5 largest, representing approximately 85% of the total increased capacity in the U.S.

Isoflow Furnaces efficiently perform two important heating functions, depending upon the butadiene process involved:
(A) To heat directly the butane-butene feed stock and steam to a high temperature for dehydrogenation.
(B) To supply highly superheated steam which in turn heats the butane-butene stock for dehydrogenation.

The unique design and operating features which have led to the wide acceptance of Petrochem Isoflow Furnaces include:

- **Uniform Heat Distribution**
- **Maximum Fuel Efficiency**
- **Low Pressure Drop**
- **Low Maintenance**
- **Zero Air Leakage**
- **Minimum Ground Space**
- **Simplicity of Design and Construction**
- **Short Length of Liquid Travel**
- **Series, Multipass, all parallel flow**
- **Excess Draft for High Overload**

For butadiene production, catalytic reforming or any other petroleum, petrochemical or chemical process there's a Petrochem Isoflow Furnace for any duty, temperature and efficiency.

PETROCHEM-ISOFLOW FURNACES

UNLIMITED IN SIZE ... CAPACITY ... DUTY

PETRO-CHEM DEVELOPMENT CO., INC. • 122 EAST 42nd St., New York 17, N. Y.

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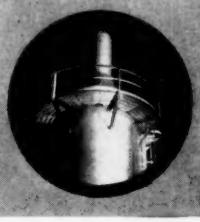


Fluoroflex®-T Molded Bellows

LAST FAR LONGER

because they're made of TEFLON® at its best

Molded, not machined for continuous, undamaged grain structure

Special compound developed for maximum flex life

High density, non-porous

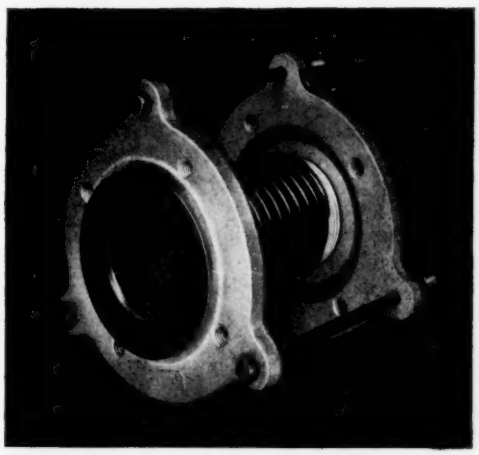
Chemically inert, universally useful, non-contaminating

BELLOWS MOLDED OF FLUOROFLEX-T offer at least 20 times the flex life and twice the burst strength (after flexing) of ordinary bellows machined from Teflon. At long last, you have chemically inert flex joints with predictable service life, even under extreme conditions.

FORGET ABOUT SUDDEN FAILURES — COSTLY DOWNTIME. One big user severely flexed Fluoroflex-T bellows 20,000,000 times...abandoned the test without a failure.

Even at *400°F.*, tested through *maximum* expansion range under full *dynamic* working pressure . . . bellows went through 100,000 cycles before tests were discontinued . . . still without failures.

NEW BULLETIN TELLS MORE — gives operating and construction data. Write RESISTOFLEX CORPORATION, Roseland, New Jersey. Southwestern Plant, Dallas, Tex. Western Plant, Burbank, Calif.



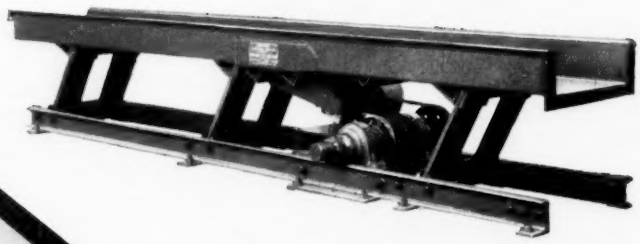
® Fluoroflex is a Resistoflex trademark, reg., U.S. pat. off.
® Teflon is DuPont's trademark for TFE fluorocarbon resins

Complete systems for corrosive service **RESISTOFLEX**

LINED STEEL PIPE • FLANGED FLEXIBLE HOSE • BELLOWS • ELBOWS • TEES • REDUCERS • DIP PIPES & SPARGERS • LAMINATED PIPE

A TRICKLE OR AN AVALANCHE

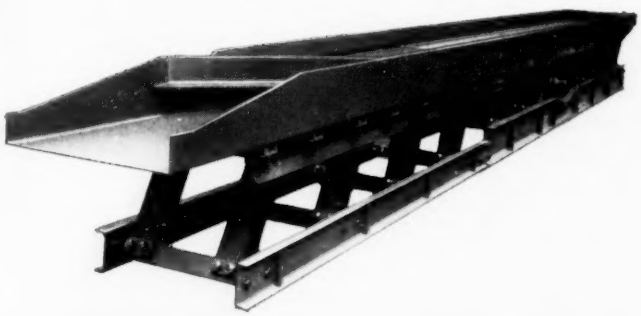
with an Electrical or Mechanical Vibrating Conveyor in any capacity



MMV MEDIUM-DUTY CONVEYOR

LMV LIGHTWEIGHT CONVEYOR

HMV HEAVY-DUTY CONVEYOR



BACK IN 1928 the Traylor Vibrator Company (acquired by Jeffrey in 1933) built the first electric vibrating conveyor, and you know what a tremendous success this line has been . . . feeders, dryers and coolers. Today they're on every class of material—feathers to lead, handling ounces and tons with equal economy and sureness.

In 1948 the men responsible for those electrical conveyors (still with Jeffrey, by the way) turned their attention to *mechanical* vibrating conveying.

First the HMV heavy-duty mechanical vibrating unit was developed—proved highly efficient and dependable, and now accepted as "standard" by all industry. Then came the MMV mechanical vibrating conveyor for medium capacities, but with the many advantages of its predecessor. Finally the lightweight, compact, low-cost LMV completed the Jeffrey line.

Catalog 860-B describes the Jeffrey long line of vibrating conveyors and their application. The Jeffrey Manufacturing Company, 907 North Fourth Street, Columbus 16, Ohio.

CONVEYING • PROCESSING • MINING EQUIPMENT . . . TRANSMISSION MACHINERY . . . CONTRACT MANUFACTURING

JEFFREY

...but air filtering isn't so simple!

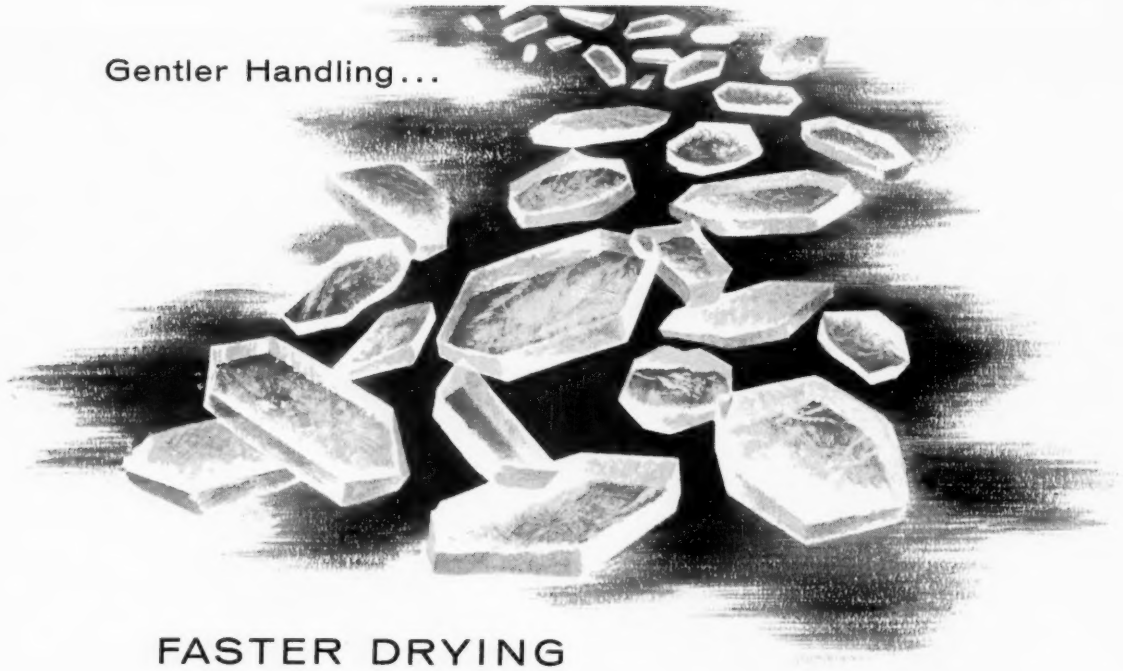
We frankly don't know which cigarette filter best meets this one requirement—removal of irritants from smoke. We do know this: no one *air* filter can possibly meet the *widely varied* clean air requirements of business and industry.

That's why AAF—and *only* AAF—makes *all* types. Regardless of your specific needs, you can be sure that AAF will recommend the one right air filter that is best for you.

A talk with your local AAF representative will show you how this complete-line approach benefits you—in dollars and results!

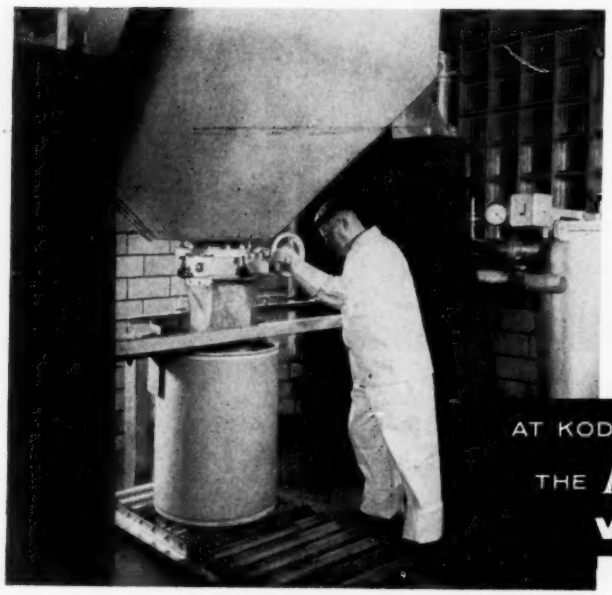
AAF herman nelson **American Air Filter**
COMPANY, INC.
326 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

Gentler Handling...



FASTER DRYING

for famed **KODAK ELON***



Faster drying at the final step of manufacture substantially increases production efficiency for Kodak Elon—thanks to Patterson's unique CONAFORM Dryer. Rapid and completely uniform drying of the batch is achieved without deterioration of crystal structure. The delicate crystals of Kodak's widely-used developing agent are preserved by the Conaform design, as the unit revolves slowly during the drying cycle. • Replacing tray ovens, the Conaform Dryer provides clean and dustless operation with complete absence of caking or contamination. Let us cite the comparisons for you.

AT KODAK PARK . . .

THE *Patterson* Conaform®

VACUUM DRYER

*Mono-methyl-para-aminophenol sulphate

ADVANCED PROCESS EQUIPMENT OF ENDURING SATISFACTION

THE *Patterson* FOUNDRY AND MACHINE COMPANY

A Subsidiary of Ferro Corporation

East Liverpool, Ohio

THE *Patterson* FOUNDRY AND MACHINE COMPANY (Canada) LIMITED

Toronto, Ontario

Chemical Engineering

Developments

FEB. 24, 1958

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Now, U. S. com'l debut for Swiss Inventa Process.... **62**

Synthetic methanol unit—the first of its kind in the U. S.—fits neatly into a key slot at Hercules Powder's integrated chemical complex in Louisiana, Mo.

Another air pollution problem is cleaned up..... **66**

U. S. Steel now takes the sting out of waspish fluorine-fluoride process emissions that once plagued Provo, Utah, herds. Result: contented—and healthy—cows.

For tool makers: plastics gain more benefits..... **74**

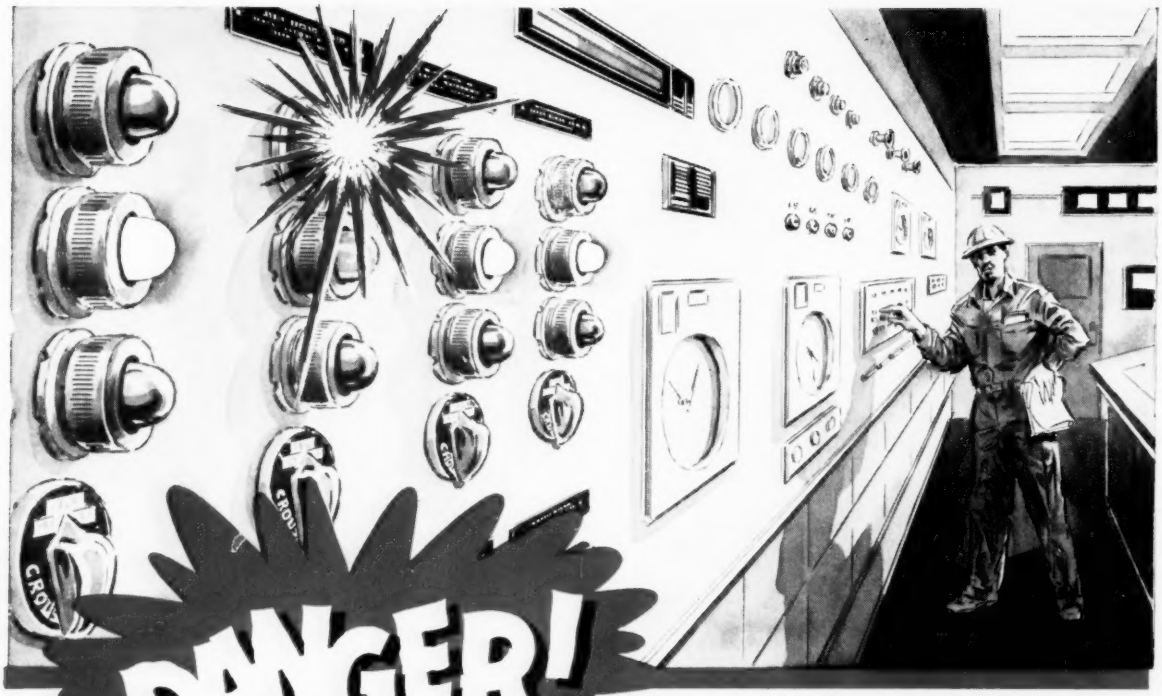
Now, new metal-fiber-reinforced epoxy composition for tooling adds outstanding impact strength, thermal conductivity and machinability to pluses offered by plastics.

What's new in chemical process equipment..... **80**

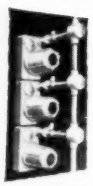
Precision specialties . . . portable reactor . . . pressure equipment . . . air springs . . . substation on wheels . . . Doyle scrubber released to industry . . . portable decontamination shower.

Propylene cracks the polymer market..... **88**

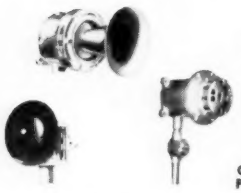
Precise orientation of monomer via just the right catalytic touch, now synthesizes solid polypropylene—soon to be a sturdy new factor in the propylene market.



. . . instantly signaled by Crouse-Hinds *Visularms*®



Condulet Visularms

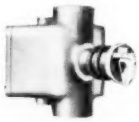


Condulet Horns, Bells & Sirens

Condulet Pilot Lights

Condulet Pushbutton Stations

Condulet Instrument Housings



Condulet Selector Switches

In oil refineries, chemical plants, synthetic rubber plants — wherever constant watch of processing is necessary — Crouse-Hinds Condulet® *Visularms* provide visual indication of process conditions, and instant control of manufacturing equipment.

By means of pilot lights (and bell, horn or siren signals where desired) *Visularm* indicates normal or abnormal temperature, liquid level, pressure, or other conditions which can be electrically coupled to the circuit.

Explosion-proof or dust-tight and weather-resistant construction* assures maximum safety in hazardous locations. Compact designs minimize space required on control or panel boards . . . are easy to install.

A Visularm system delivers substantial savings by eliminating the necessity for buying individual components . . . housing them . . . and wiring your own system completely.

Two- or three-light styles may be mounted either vertically or horizontally. For audio warning, any number of *Visularms* may be used to operate a single horn, bell or siren.

Visularms are just one of hundreds of items in process control board equipment offered by Crouse-Hinds. Only a few are shown at left. For full information on the complete line, call your nearest Crouse-Hinds distributor, or write . . .

*Dust-ignition-proof.

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DEVELOPMENTS . . .

FEBRUARY 24, 1958

Chementator

C. H. CHILTON

√A new cement process out of Australia permits feeding a wet slurry of raw materials into a vertical kiln.

√Hot potash absorption (see item at right) finds still another new job. Standard Oil (Calif.) is now using it in a new carbon dioxide plant.

√Ethyl alcohol, added to urea-containing cattle feed in small amounts, enhances its palatability, speeds up rate of metabolism and produces meat of improved quality.

√Richfield Oil will soon enter the petrochemical business with an 18-million-gal./yr. benzene plant near Long Beach, Calif. Despite national oversupply situation, the company looks to growing West Coast markets to sop up its output.

Hot potash plus MEA treats sour gas

Two-step absorption system—hot potassium carbonate followed by monoethanol amine—promises to cut investment, fuel and maintenance costs in treating sour natural gas. It will also make it economically sound to treat sour gas which otherwise might be flared into the air and wasted, says Julian Foster, vice president of Lone Star Producing Co., Dallas.

Lone Star has just begun building a 100-million-cu.-ft./day gas treating plant to use this system in Atascosa County, Tex. Gas to be treated contains 1,300 grains of H_2S per 100 cu. ft.; this will be reduced to 0.25 grain to meet pipeline specifications. Initial 6½% CO_2 content will be comparably reduced.

The hot (240 F.) potash absorption method, originally developed by Bureau of Mines for removing CO_2 from Fischer-Tropsch synthesis gas, has recently been put to work on ammonia synthesis gas (*Chementator*, Apr. 1956, p. 103). Despite its attractive cost features vs. MEA absorption, natural gas producers have shied away from the hot potash method. Reason: It can't turn out a sweet enough gas.

Lone Star's answer to this dilemma is to do 90% of the job with hot potash, take care of the rest with MEA. A company engineer believes it will be first such installation in natural gas processing.

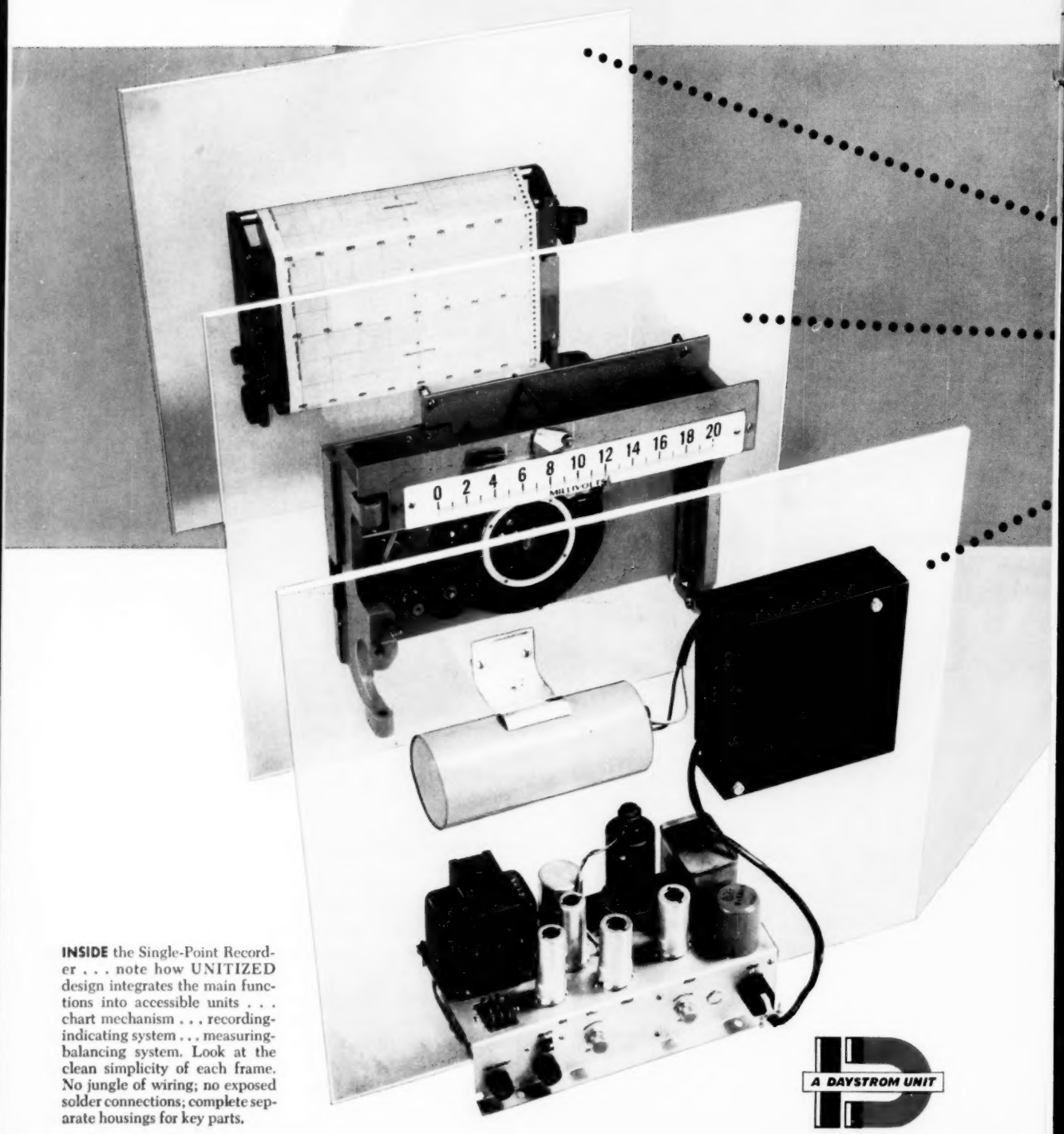
From nuclear radiation, nitric acid

At least two industrial groups are vying for the chance to exploit on a commercial scale Rensselaer Polytechnic Institute's basic discoveries in fixation of atmospheric nitrogen via nuclear radiation.

Paul Harteck and Seymour Dondes of RPI have carried their original laboratory work through pilot-plant scale at Brookhaven National Laboratory. Next steps would be design and construction of a multimillion-

(Continued on page 58)

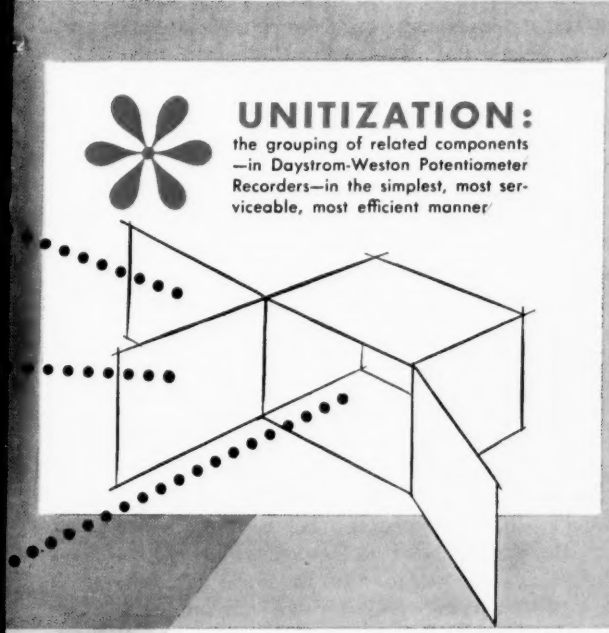
UNITIZATION*



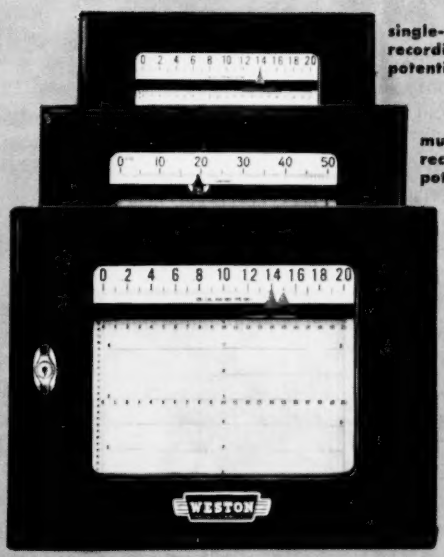
INSIDE the Single-Point Recorder . . . note how UNITIZED design integrates the main functions into accessible units . . . chart mechanism . . . recording-indicating system . . . measuring-balancing system. Look at the clean simplicity of each frame. No jungle of wiring; no exposed solder connections; complete separate housings for key parts.

A DAYSTROM UNIT

pays off BIG!



UNITIZATION:
the grouping of related components —in Daystrom-Weston Potentiometer Recorders—in the simplest, most serviceable, most efficient manner



GREATER DEPENDABILITY . . . LOWER MAINTENANCE . . . EASIER SERVICING

stem from WESTON's exclusive UNITIZED instrument design!

Trouble-free instrument service begins with design. Weston's unitized design – unequalled for simplicity – makes possible longer, more accurate performance . . . eliminates on-the-line headaches and inconveniences.

• **HIGHEST RESOLUTION** is made possible by use of 2500-turn universal slidewire. No competitive instrument offers a comparable slidewire.

• **GREATEST TIME SAVINGS** in routine servicing: Charts are installed in seconds; pen is filled without removal, and restarts instantly.

• **LOWEST SPARE-PARTS INVENTORY:** Amplifier uses standard tubes; matching is unnecessary. A single amplifier serves all speeds and sensitivities. Slidewires, range standards and alarm components are interchangeable.

• **SIMPLEST MAINTENANCE:** All inspection and servicing is done from the front of the instrument. Entire amplifier can be quickly removed for servicing without breaking any soldered connections.

• **COMPACTNESS:** These are the smallest case, standard chart size potentiometer instruments offering guaranteed ¼% accuracy. Less panel space is required. Instruments mount in standard radio or relay racks.

• **VERSATILITY:** Range standards are instantly changed on exclusive range panel. Chart speeds are changed with a simple screwdriver adjustment. Instruments easily adapt to special equipment, such as alarm circuits.

• **RESISTANCE TO SHOCK,** vibration, corrosive atmospheres: Key components have complete separate enclosures, yet are readily accessible. Shock tests prove instruments practically immune to mechanical damage.

For more complete information, call your local Weston Representative, or write . . . WESTON INSTRUMENTS, Division of Daystrom, Inc., Newark 12, N. J.

DAYSTROM-WESTON

Industrial Instruments

dollar prototype commercial reactor. Announcement of such a venture may be forthcoming soon.

The RPI researchers have obtained yields of nitrogen oxides on the order of 5-15% by exposing compressed air to radiation from uranium-235. Preferred conditions: Pressure, 150 psi. and higher; temperature, approximately 400 F.

In the desired chemical reactions, nitrogen and oxygen molecules are ionized and decomposed by fission fragments as well as by beta and gamma radiation. This requires that U-235 be in a finely dispersed form and in direct contact with the gas.

To achieve these objectives, Harteck and Dondes have developed a nuclear reactor fuel matrix consisting of glass fiber into which has been incorporated the oxide of U-235 (*Chem. Eng.*, Jan. 27, 1958, p. 70). This form of fuel has been found to be several times as effective as the fine oxide powder used in earlier work at RPI. Besides making a greater amount of fission recoil energy available, the fibrous form provides a large surface area for good heat transfer.

Cost of nitric acid from the proposed process would depend to a large extent on efficiency with which nuclear energy is converted into chemical reaction energy. At 50% efficiency, 1 mole of U-235 in 20%-enriched form (worth about $6,000) will produce some 70 tons of fixed nitrogen (worth about $10,000). Economics would be improved further by operating at a high-enough temperature level (say, 500-600 F.) to permit generation of steam from a dual-purpose reactor.

No fouled tubes in new salt process

International Salt Co. will put its new salt refining process to the commercial test this summer. After going through two 25-ton/day pilot plants at Watkins Glen, N. Y., the process moves to a 500-ton/day scale via a $750,000 project at Avery Island, La.

Conventional salt refining operations use multiple-effect calandria-type vacuum pans, or multiple-effect crystallizers with forced-circulation outside closed heaters. International's novel technique eliminates all tubular heating surfaces, slashing investment and maintenance costs. Steam consumption is also much lower.

In the new process, crude salt is continuously slurried in cool, saturated brine. The slurry is then heated to about 225 F. by open steam to dissolve the solid salt. Insolubles are removed by settling and filtration. The clarified hot, saturated brine then goes to a double-effect vacuum flash crystallizer made of Monel. The amount of vapor released here will be about the same as that used in the original heating, and the amount of salt crystallizing out during the cooling process will be about the same as that dissolved in the saturator. After separation of refined salt, the cool brine repeats the cycle.

International's R. B. Richards points out that the original pilot plant (*Chem. Eng.*, Mar. 1952, pp. 140-3) was redesigned to provide withdrawal of salt slurry from each crystallizer effect into retention settlers. Retention of slurry for 25-30 min. allows buildup of solids concentration (to 20%) and gives a product of improved crystal size.

Double cone avoids bin constipation

Coal users' perennial headaches with plugged bins have spawned a new bin discharger that may end stoppage problems, should win acceptance in other fields.

Developed by Bituminous Coal Research, Inc., Columbus, Ohio, the Easy-Flo bin has now passed from the pilot stage into full-scale commercial testing on a 10-ft.-dia. by 40-ft.-high silo. Already 12 companies are actively considering installation of units, including one for salt. BCR grants licenses through materials handling specialists, rather than directly to users.

BCR's initial basic study established that the conventional storage bin discharges poorly because solids tend to move down through the bin as a central core. That's why pressures rise, ratholes form and material sticks to the hopper walls.

To overcome this difficulty, BCR designed a hopper for bin bottoms which makes solids throughout the bin move downward as one plug. Cylindrical with a tapered 75-deg. cone bottom, hopper contains a 77-deg. cap cone to make solids flow down the hopper walls rather than as a core converging toward the outlet. Pressures remain so low that flow can be regulated manually with ease.

International Salt Co. next month will erect a Neff & Fry-designed bin and hopper at Avery Island, La. An Easy-Flo hopper will

(Continued on page 60)

HOW TO OBTAIN

greater throughput

IN SCRUBBING OPERATIONS

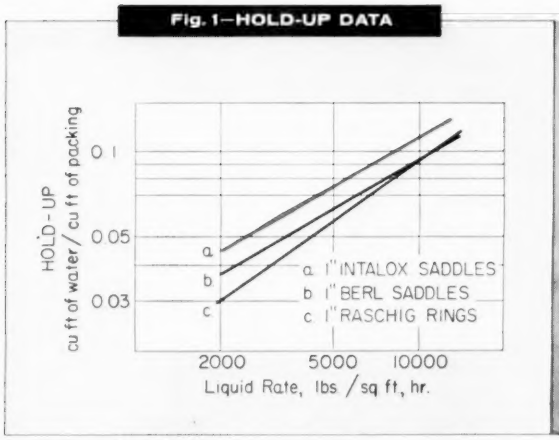
Greatest throughput in scrubbing operations is obtained at a balance point where maximum wetting of the packing occurs without flooding the tower. Maximum wetting involves a higher liquid hold-up.

Intalox saddles pack with greater randomness, form a loosely packed, yet tightly interlocked bed free from blocked areas, with higher surface area, and what is especially important, as far as throughput is concerned, provide a bed of greater and more uniform voidage.

As a result it is possible with Intalox saddles to have a higher liquid hold-up than with other packings yet still retain the low pressure drop characteristics of Intalox since the higher liquid hold-up results from a greater wetted-surface-area rather than from liquid-filled voids.

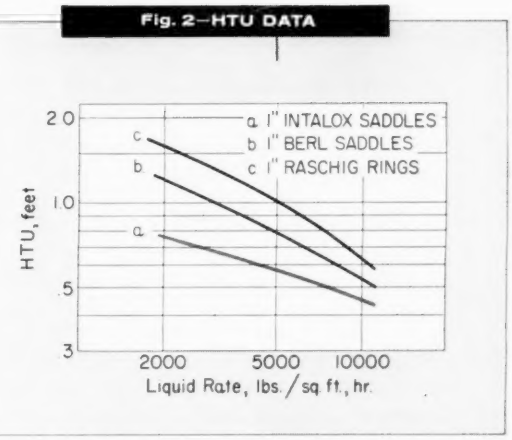
This ability to give higher liquid rates without flooding is reflected in substantially better mass transfer performance.

Fig. 1—HOLD-UP DATA



Higher liquid hold-up of Intalox Saddles reflects the better accessibility of the packing surface to liquid, thus greater wetted-surface area. Voids remain open, pressure drop low.

Fig. 2—HTU DATA



The capacity data shown are typical for a system where both gas and liquid film resistances are involved. Lower HTU values mean shorter towers, less pressure drop and reduced initial investments.

Write for this free booklet:

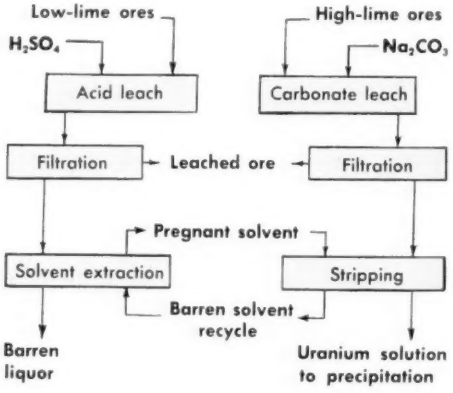
Bulletin S29-R gives full technical data on Intalox Saddles, performance charts, typical problems and solutions. Address: Dept. CE-457 U. S. Stoneware, Akron 9, Ohio.

U. S. STONEWARE

AKRON 9, OHIO

481-E

be attached to a 16-ft.-I.D. by 60-ft.-high concrete bin having a 60-deg. sloped bottom. Hopper will discharge approximately 40 tons/hr. of salt onto a conveyor in a tunnel under the outlet, feeding to the new refining process described above.



Uranium mill joins alkaline, acid routes

Novel combination of alkaline and acid leaching with solvent extraction will feature new 500-ton/day, $3.5-million uranium mill to be put up at Riverton, Wyo., by Fremont Minerals, Inc.

Mill will handle both low-lime and high-lime ores. Low-lime ores will be acid-leached and solvent-extracted according to conventional practice (*Chem. Eng.*, Apr. 1957, pp. 148-150) up to the solvent stripping step.

Here, instead of using plain soda ash solution to strip uranium from the solvent, Fremont will use the liquor from carbonate leaching of high-lime ores. Acid-leached uranium thus winds up in the carbonate solution.

Fremont's dual circuit will be flexible enough to handle a wide variety of ores. Process has been tested at AEC's Grand Junction pilot plant with recoveries of 95-96%.

Another possible innovation: Fremont is considering use of amines in solvent extraction instead of the usual phosphoric acid esters.

Now, Sanforized wrapping paper

Stretchable paper is the latest brainchild of top fiber specialist Sanford Cluett, creator of the Sanforizing process.

By applying compressive shrinkage to fourdrinier paper during drying, Cluett imparts extensibility to boost several-fold the finished paper's resistance to impact shock. The new paper does this better than regular creped grades because it is much harder to stretch, thus absorbs greater amounts of impact energy.

West Virginia Pulp & Paper Co. put the new process into commercial use early this year on a new $25-million, 80,000-ton/yr. kraft machine at Charleston, S. C. By midyear other papermakers will be able to license the process through Clupak, Inc., joint offspring of Westvaco and Cluett, Peabody & Co.

At present, Westvaco will produce Clupak paper in various kraft grades with stretch as high as 13%. Major markets will be grocery bags and multiwall shipping sacks. However, process's broader scope is indicated by the company's admission of current plans to install it on a small specialty paper machine that makes white paper.

New way to part uranium isotopes

A new German method for separating gaseous isotopes has been hailed in that country as an important step in Germany's progress in the field of nuclear energy.

Erwin Becker of Marburg University has carried out laboratory research on the so-called pressure diffusion process, using argon and carbon dioxide isotope mixtures to determine relations of the basic parameters. Separation of uranium hexafluoride isotopes will be studied further in a pilot plant now under construction at Marburg.

Process involves supersonic flow of gas through a small nozzle directed towards another small "stripper" opening a short distance away. Nozzle and stripper are both contained within an evacuated chamber. Some of the gas issuing from the nozzle is thus peeled away from the stripper opening. The heavier isotope, with its greater inertia, will tend to concentrate in the fraction leaving the stripper.

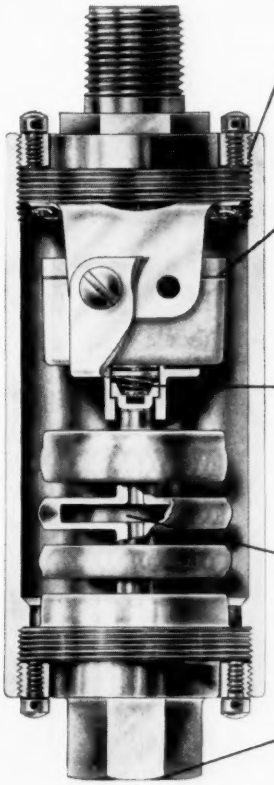
A typical test with UF_6 used these conditions: Nozzle diameter, 0.5 mm.; stripper opening, 1.8 mm.; nozzle-stripper distance, 0.15 mm.; pressure at nozzle, 10 mm. Hg; pressure in stripper and in vacuum chamber, about 0.02 mm. Hg. Process works at room temperature.

For more on DEVELOPMENTS.....62

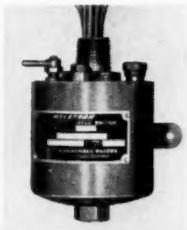
PRESSURE SWITCHES FOR **HIGHLY CORROSIVE** MEDIA

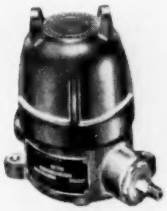
This new tier-tube line of Meletron pressure switches is available in materials suitable for use with concentrated hydrogen peroxide, fuming nitric acid, liquid oxygen, proprietary amine fuels, fluorine, mixtures of fluorine and liquid oxygen and others.

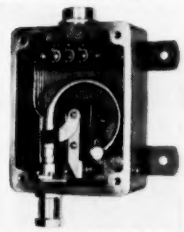
Proof pressures range from 224 to 6000 P.S.I., pressure settings from 2 to 4800 P.S.I. Switches will operate in temperatures from −65° to +275° F. Standard pressure port fitting is ¼" internal pipe thread but may be substituted by special welding fitting. The housing serves as a pressure tight safety capsule in case of a break in the sensing element. Single pole double throw switching elements are rated to 10 amps., for AC and DC circuits. Free leads or Cannon plug are optional for electrical connection. As an added safeguard, the stainless steel models will withstand 2000° heat for five minutes.


Threaded (adjustable) Construction shown; Welded construction optional
Snap action Switch
Overtravel protection
Tier-tube sensing element — not to be confused with an accordion diaphragm.
¼" internal pipe thread pressure connector is standard — Welding fitting optional.

For Long Operating Life


Vacuum and LOW Pressure


For Explosive Atmospheres


Pressures to 12,000 P.S.I.

A complete line of several hundred standard models, off-the-shelf items, includes everything from vacuum to 20,000 P.S.I. proof pressure.

All have these features built in:

ACCURACY and DEPENDABILITY
maintained during operating life due to direct acting design.

OPERATION IN ANY POSITION
which saves the installation costs encountered in mounting a switch that uses liquid switching elements.

IMMUNITY TO VIBRATION
you can mount the switch directly on your vibrating or moving equipment.

We don't use

LINKAGES and BEARINGS

which as they wear, make the setting of the pressure switch drift.

We don't use

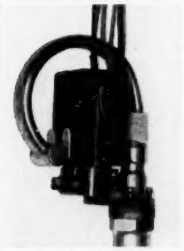
LIQUID SWITCHING ELEMENTS

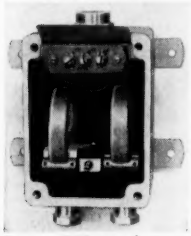
which make the switch difficult to mount and very critical to vibration.

We don't use

ACCORDION DIAPHRAGMS

which make the pressure switch sensitive to vibration.

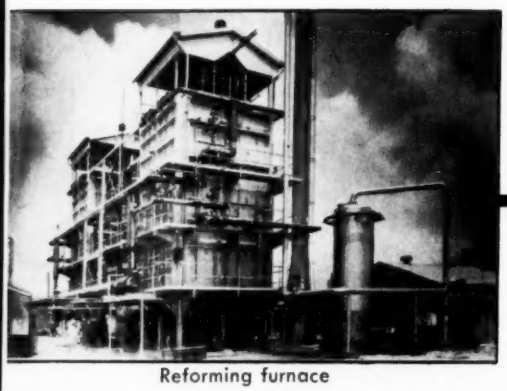

Skeleton Switch


Pressure Difference Switches

BARKSDALE VALVES

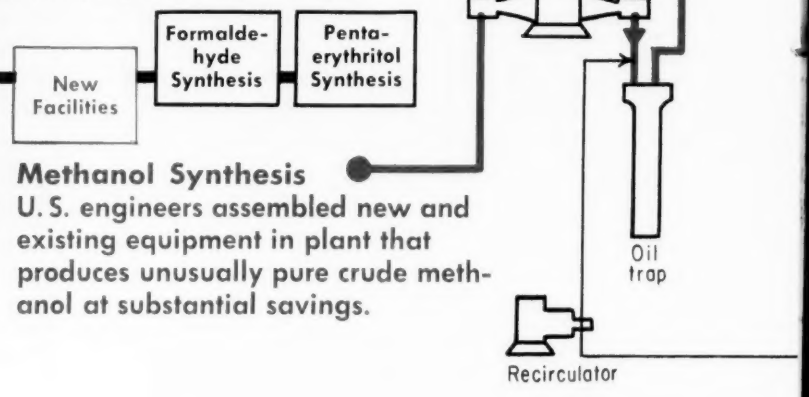
PRESSURE SWITCH DIVISION

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA



Reforming furnace

Existing Facilities produce gas for old ammonia synthesis operation and for new methanol plant. At present, formaldehyde unit takes full product methanol stream.



Methanol Synthesis
U. S. engineers assembled new and existing equipment in plant that produces unusually pure crude methanol at substantial savings.

First U. S. Inventa Methanol Plant Fills

Hercules' new methanol plant completes integration of processes to convert natural gas to pentaerythritol. Design tied used equipment into new process

The Inventa-Vulcan route to synthetic methanol is now launched on its commercial debut in the U. S., thanks chiefly to a highly acclaimed new catalyst and a strong assist from American engineering.

Since November, Hercules Powder Co.'s 70-ton/day (7-million-gal./yr.) methanol plant at Louisiana, Mo., has been onstream, harnessing the high-pressure flowsheet developed by Inventa AG, Ems, Switzerland. Outstanding feature of process is unusual purity (92-93%) of crude methanol stream from synthesis-gas converter, which simplifies subsequent purification.

Engineering and construction of Hercules plant was handled by Vulcan-Cincinnati, exclusive U. S. licensor of the process. Next Inventa-Vulcan methanol plant to come onstream will be Borden International's unit now under construction at Cubatao, Brazil.

▶ **Key Slot**—Hercules new plant fits into a key slot at the integrated installation that's been a-building at Louisiana since early last year.

It takes its synthesis-gas feed from natural-gas, steam-reforming furnaces, previously in place, which also supply Hercules' ammonia facility. Then, all the methanol product feeds the new (Jan., 1957) formaldehyde installation nearby, although at a later date some of this methanol may be diverted to market. Formaldehyde, in turn, serves as feed for manufacturing pentaerythritol in a plant onstream since March, 1957.

▶ **Catalyst Cuts Costs**—To this pivotal job in Hercules integrated complex, the Swiss process brings an attractive list of cost-cutting features. And Vulcan points out that credit for most of them goes to the catalyst.

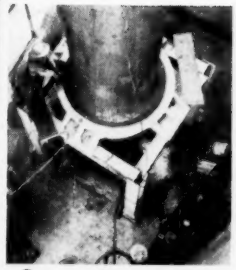
Catalyst provides high selectivity at low operating temperatures (325-380 C.) to inhibit side reactions that form contaminating methane, dimethyl ether and higher alcohols. That's why Hercules can turn out an unusually pure crude methanol stream and get away with a comparatively simple and inexpensive facility for purifying the crude.

Long catalyst life (upwards of 18 mo.) and high life capacity (about 25 tons methanol/liter catalyst) reduce plant downtime and labor to replace catalyst.

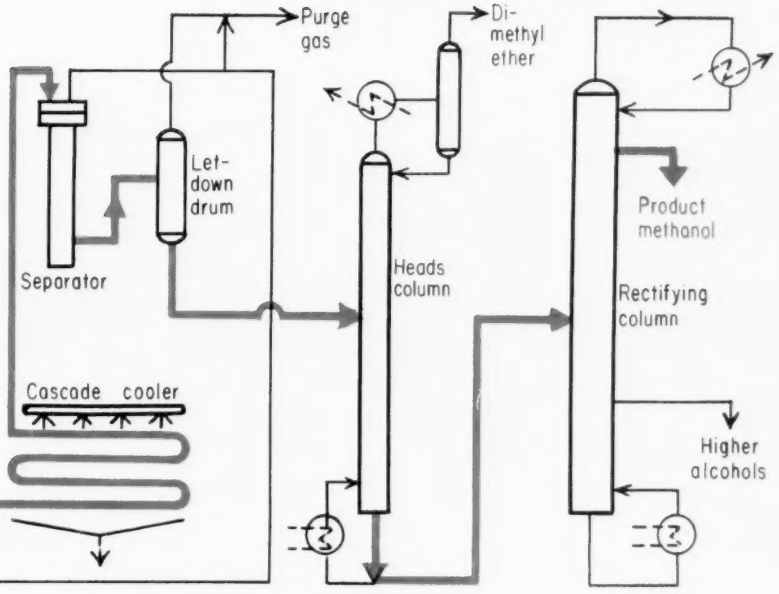
Catalyst volume shrinks less than 10% during operation because it's preshrunk. This eliminates need for costly shutdowns to bring catalyst bed back up to specified volume.

Activity of the catalyst is affected little by shutdowns. This has proved particularly valuable during plant's shakedown period when Hercules shut down and started up frequently while ironing out operating bugs. In storage, catalyst can be held for about two years without losing activity.

With this catalyst, rate of synthesis is high. And catalyst won't dust, break or poison easily.



Converter
New catalyst holds secret to converter's unusual effectiveness.



Open Slot at Integrated Chemical Complex

▶ **What's the Secret** — Mainly, the secret behind such peak effectiveness seems to be knowhow rather than startling new materials. Though not free to reveal much detail about the catalyst, Vulcan indicates its composition is similar to others used in methanol synthesis by companies both here and abroad. But, Vulcan stresses that the catalyst's success stems from its physical character and the technique used to manufacture it.

▶ **Two Major Factors in Choice** —Despite these overbearing advantages of catalyst performance, there were two other factors that had major bearing on Hercules' choice of the Inventa process: — process availability and adaptability to use of existing equipment.

Most synthetic methanol processes with convincing onstream histories in the U. S. A. were developed by methanol manufacturers. As might be expected, due to competitive conditions these manufacturers are not eager to make attractive licensing offers.

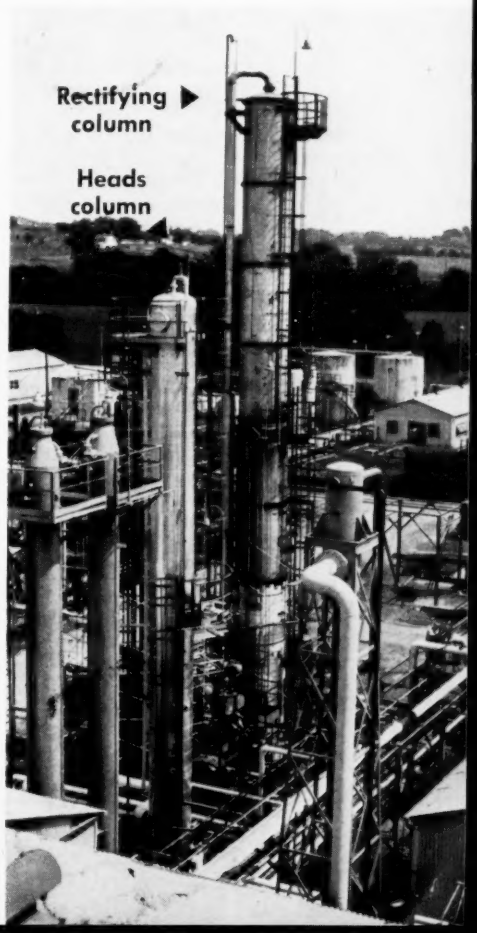
Turning to Europe, Hercules was attracted on one hand by the onstream record posted by Inventa's methanol process at Holzversuckerungs AG., and on the other hand by its economic availability.

Before it could reach a final decision, however, Hercules had to turn its eyes homeward and determine how to fit the Inventa process into the existing picture at Louisiana, Mo.

Originally, the Louisiana facility was a government installation that Hercules bought lock, stock and barrel in 1954. As a result, Hercules possessed a wealth of equipment that it was anxious to use in the methanol plant.

In order to use this equipment for the Inventa process, Hercules first had to undertake the monumental task of taking inventory and examining individual items. Working as a team, Hercules and Vulcan completed this task. Subsequently, Vulcan adapted pressure vessels, compressors and even piping and fittings from this equipment stockpile.

▶ **How Process Works** — Some 4,880 scfm. of synthesis gas goes to a six-stage, 3,000-hp. reciprocating compressor to be brought



to about 5,500 psi. Between the third and fourth compressor stages the stream is scrubbed free of carbon dioxide in two, 55-ft.-tall by 3-ft.-dia., saddle-packed monoethanolamine scrubbers.

Gas stream, at ambient temperature, passes through an oil trap, then to a steel, 40-ft.-tall by 3-ft.-dia. pressure vessel capable of withstanding 10,000 psi. This converter is filled with the catalyst and fitted out with a tube bundle in its lower section.

Gas enters the top of the unit and flows down the outside of the catalyst bed and over the tube bundle. Then it flows up through the bed where the methanol-making reaction takes place at about 325-380 C. Stream then returns through the catalyst bed and exits from the converter through the tubes. In this way incoming gas is preheated to reaction temperature.

▶ **Finishing Step** — Stream is condensed in a water-cooled exchanger and enters a separator. Gaseous products leave the top of the unit and recirculate through a steam-driven, 600-hp. reciprocating booster compressor to join fresh feed at the oil trap. Crude methanol from the bottom of the separator goes to a flash drum to be let down to 400 psi. before entering the finishing stage.

Methanol purification takes place, essentially, in two stainless-steel distillation columns; a 60-ft. sieve-tray "heads" column and an 80-ft. bubble-cap rectifying column.

Low boiling compounds and side-product dimethyl ether are taken as overhead from first column, crude methanol as bottoms. Then higher alcohols are taken off as heart cut from second column and water as bottoms. Overhead is 99.85% product methanol that goes to storage.

Refinery Calcining Gives A1-Grade Petroleum Coke

Long considered a low-grade byproduct of refining operations, petroleum coke is taking on added significance in economics of at least two refiners.

Continental Oil Co. has a new 85,000-ton/yr. coking-calcining unit on stream at its Lake Charles, La., refinery. Coking operation provides an alternative outlet for Bunker C fuel oil that has been in long supply recently.

Currently, Conoco and American Gilsonite Co. are the only two refiners marketing a calcined coke product suitable for aluminum-reduction electrodes. Most aluminum producers now calcine ordinary petroleum coke in their own plants to remove the harmful volatile matter.

Conoco's installation is a conventional delayed coking unit up to the calcining step. From conventional coking drums, coke is dewatered and sent to calcining silo. After calcining for two hours at around 2,400 F., coke is screened, oversize crushed, and product sent to storage.

Hot coke leaving calciner is cooled in a water spray but there's the problem of getting enough water to cool large chunks without mudding finer particles. A vibrating conveyor provides the solution: Larger particles lift to surface of vibrating bed, receive most of water spray. Coke leaves water spray at 300 F., hot enough to insure complete evaporation of all cooling water.

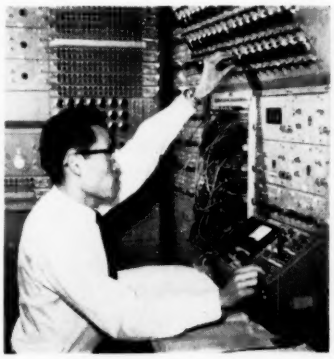
Montecatini Revives Fertilizer Process

Montecatini, Italian chemical producer, has resurrected an old German fertilizer process for recovering potassium sulfate from kainite ore. Process is being installed in plant going up near Campofranco, Sicily.

This much is known about Montecatini's version: Sodium chloride impurities in raw kainite ore are removed by flotation. Kainite ore pulp is concentrated in decanters, filtered and leached with water. Potassium sulfate is recovered from leach liquor by special crystallization step.

Raw kainite (a natural salt containing potassium and magnesium sulfates, magnesium chloride) obtained from nearby mines, runs an average 12% K_2O titer. Plant will turn out 350 tons/day fertilizer-grade potassium sulfate when on stream in early 1959.

Process was originally developed in Germany but abandoned because of engineering problems. Improvements that Montecatini made in crystallization step are being guarded under tight security wraps.



Process Dynamics Now Get Computer Scrutiny

In its St. Louis headquarters, Monsanto Chemical Co. is initiating a new look in experimental chemical processing.

Monsanto's systems-engineering section is now equipped with a new $175,000 analog computer for solving problems in process control and design. This computer, modified for Monsanto by Electronics Associates, Long Branch, N. J., is first analog unit designed exclusively for analyzing chemical processes.

Computer studies dynamic systems, evaluates effect of random changes in process inputs, reaction conditions and other independent variables. Thus, Monsanto hopes to bypass pilot-plant studies, reduce plant investment through more careful design. Monsanto also looks for these additional benefits: Less time and effort spent on research, aid in designing automatic control systems, higher yields and more uniform product quality through optimizing reaction conditions.

Monsanto's systems section teams a chemical engineer with an electronics engineer in working problems on the big computer. Chemical engineer's knowledge of process and reaction systems is merged with electronics engineer's knowledge of computers and control systems.

where technical service is

a proven FACT!

What should a supplier offer in the way of technical help?

With Oronite this *is not* a loosely used term to describe technical assistance which is implied but can't be delivered. Technical Service from Oronite is a defined course of action embodying a group effort of scores of technically trained people specializing in product applications to specific industries.

Field representatives are familiar with Oronite products and their applications; product specialists continually supply technical data to the field men; in the laboratories, sections of research chemists and engineers devote full-time exploring and documenting new factual data on Oronite products and their uses.

Most important is the Oronite philosophy of translating research and technical service to your individual needs. Oronite recognizes that each raw material application is different but that helpful supplementary assistance can be provided on an individual basis.

When a company becomes an Oronite customer, *technical service* continues — providing the customer new data as it develops, suggesting ways of cutting costs, cooperating in every way possible to make your association with Oronite more valuable.

Yes, Technical Service at Oronite is a FACT. Why not call on Oronite and see for yourself the depth of our technical assistance on your problems.

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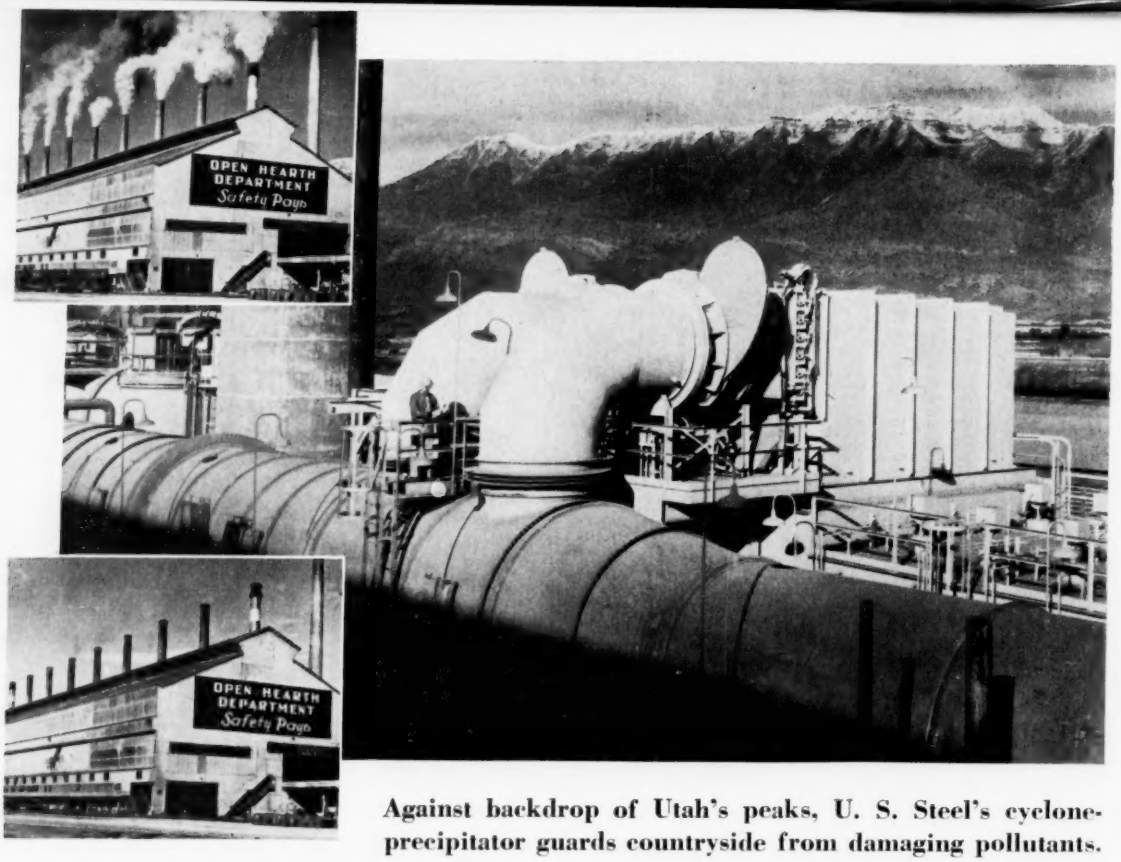

Against backdrop of Utah's peaks, U. S. Steel's cyclone-precipitator guards countryside from damaging pollutants.

Giant Fume Catcher Stops Fluoride Emission

Combining two magic ingredients—ingenuity and money—U. S. Steel Corp. has come up with a highly effective answer to a troublesome air-pollution problem plaguing its Columbia- Geneva mill near Provo, Utah.

The fluorine-fluoride emissions from steel mill's stacks were contaminating nearby grazing land and damaging dairy herds. Voluntary payments to farmers had cost USS $4 million before a satisfactory control scheme could be developed and put into operation.

Working with Research-Cottrell, prime contractor on the project, USS found the answer: Tie up fluorine with calcium compounds and remove fluoride particles from exit gases via cycloning and electrostatic precipitation. Requiring seven years to develop, method removes about 96% of. fluorine and fluorides in effluent; represents a $9-million investment by U. S. Steel.

▶To Give Contented Cows — Minnesota iron ore handled at the Columbia-Geneva mill has a relatively high fluorine content; charges to furnaces run around 0.003% F. During sintering and open hearth operations, ore's fluorine content is volatilized and goes up stack as a mixture of fluorine gas and fine fluoride particles. This material, depositing on nearby grassland, is ingested by grazing cattle and concentrates in their bones and teeth. Ultimately, it can impair mastication and milk production.

USS's solution rests on the rapid gas-solid reaction between fluorine and calcium compounds, both carbonate and hydroxide, to give calcium fluoride. Essentially, fluorine-containing gases are collected, calcium hydroxide dust injected into ducts and fluoride particles removed in the cyclone-precipitator section. The 1-million-cfm. capacity of the precipitation system makes it world's largest.

▶Two-Part Answer — Fluorine emissions were issuing from two separate locations in the USS mill, the sintering plant and the open hearth department. Although presenting different problems, treatment is based on same basic principle.

In sintering plant, coke and iron ore are heated on a moving belt to form fused particles suitable for charging to blast furnace. Most of ore's fluorine content is volatilized here.

USS found that mixing powdered limestone directly in with sinter charge reduced fluorine emissions by 50% without harming sintering properties. Calcium fluoride formed remains in sinter charged to blast furnace and eventually passes off when slag is tapped.

Gases from sinter plant at 800 F., containing 150 ppm. fluorine, are collected. Hydrated lime dust (95% passing through 325 mesh) is injected into collecting duct at two points at total rate of 20 lb./min. With gas flow

HOW'S THIS FOR A TOUGH SERVICE?

The Rockwell-Nordstrom lubricated plug valves shown above handle carbon bisulfide while immersed in water and operated dozens of times each day!

These are the kind of services that ruin ordinary valves so quickly . . . the Rockwell-Nordstrom valves shown above are the *original* valves, not a one has had to be replaced!

Rockwell-Nordstrom valves stay in service longer because the critical seating areas between the plug and the body are *never* exposed to the line. They assure far tighter shut-off than ordinary valves because pressurized lubricant forms an instantly replaceable "soft seat." And, lubricant eliminates metal-to-metal wear for longer valve life, lower cost.

Rockwell-Nordstrom valves are available in semi-steel, steel, stainless, bronze, Monel and other corrosion resisting metals in a complete range of sizes. They cost no more to buy, often less, than ordinary valves. For details, see your supplier or write: Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

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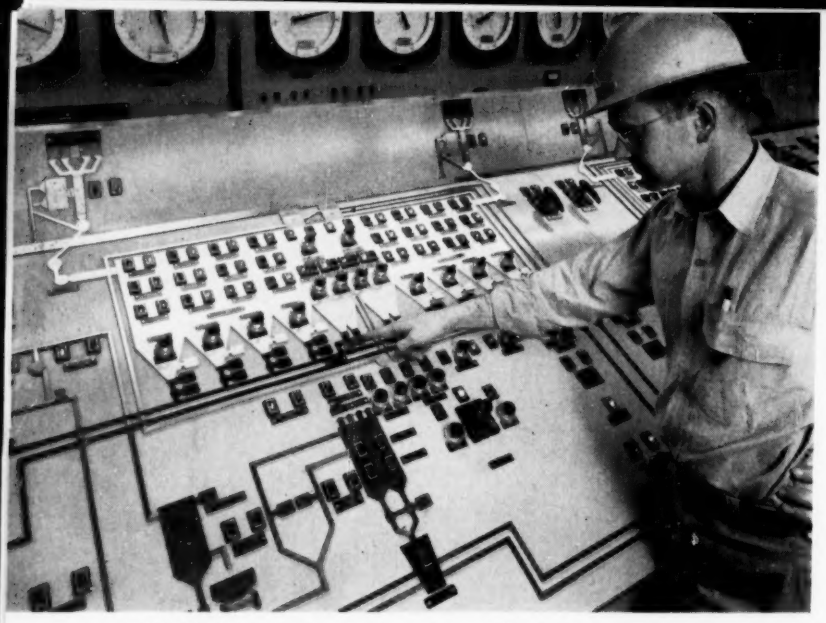

OPERATOR controls open hearth precipitator from console panel, one of eight in fume-catcher installation.

LAB MAN samples effluent gas regularly from stacks.

AGGIE scientist checks end result by photographing cow's teeth.

rate around 220,000 scfm., contact time is about 13 sec.

▶ **Need Second Shot**—From collecting duct, gases containing 0.4% solids enter the cyclone-precipitator unit. Bulk of solids are removed by cycloning.

Then, to complete reaction, powdered limestone (80% through 200 mesh) is injected at two points at a total rate of 64 lb./min. After contact time of a few seconds, gases pass into electrostatic precipitators which remove most of remaining particles.

Limestone, although cheaper than calcium hydroxide, cannot be injected before cycloning because it is coarser and would wear out the cyclones.

▶ **Variation on a Theme**—Gases from the ten open hearth furnaces receive a similar treatment. Collected at 600 F. and containing 160 ppm. fluorine, flow is channeled into main 16-ft.-dia. distributing duct.

At eight discharge points of distributing duct, 7 lb./min. lime dust is injected into gas stream. Contact time is about 10 sec. with total gas flow of 450,000 scfm.

Flowing through cyclone-precipitator units, around 96% of effluent's fluorine content is removed. There's no need for a second limestone addition in the open hearth treating section.

Engineers hit one major snag working up this flowsheet; dry calcium fluoride will not take an electrostatic charge. This hurdle was cleared by injecting steam into the collecting mains keeping humidity around 20%. Thus moistened, CaF_2 is readily precipitated.

The open hearth treating section alone uses 2.4 million lb./day steam. This steam requirement is generated by passing hot waste gases through waste heat boilers.

▶ **Lime In, Dust Out**—A total of 115 tons/day dust is removed from effluent gases by the precipitating units, 50 tons from sinter plant and sixty-five tons from open hearths. In this total, there is 1.5 tons of fluorine from sinter plant and 2.5 tons of fluorine from open hearths.

In open hearth treating section, there are eight precipitator units serving the ten furnaces. These units, supplied by Research-Cottrell, each have 80 16-in.-dia. cyclones, 140 collecting electrodes and 816 discharge electrodes. Power consumption is about 25 kw. per precipitator; collection efficiency is around 96%.

The two precipitator units serving the sinter plant are essentially the same.

Collected dust is discharged into hoppers, agglomerated to prevent its blowing around and dumped on slag heaps. Eventually, USS hopes to find some commercial use for fluorine values presently being thrown away.

▶ **Cows Give Clue**—Concentration of effluent fluorine in bones and teeth of dairy cattle, symptom of pollution problem, also furnished the clue for solving the problem.

USS engineers could find no other steel plants that had been faced with a similar problem. Some industrial installations remove fluoride particles with scrubbers; but trying this method on a pilot-plant scale, USS found that fluorine gas formed HF solution and caused severe corrosion problems.

Then engineers wondered if the affinity of fluorine for calcium in animal bones could be used to advantage in treating the effluent gas. Pilot studies showed it could. From there it was just a matter of scaling this basic idea up to plant operation.

News from
National Carbon Company
Division of Union Carbide Corporation · 30 East 42nd Street, New York 17, N. Y.
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National Carbon representatives expand your engineering force

J. F. BRAUNING, SALES ENGINEER

Mr. Brauning graduated from M.I.T. with a M.S. in chemical engineering. Prior to joining National Carbon Company, he was active in research and development with a large chemical company in the East.

Mr. Brauning's first two years with National Carbon were spent in initiating design proposals on the basis of customer inquiries. Later he worked for two and a half years developing new designs and improving existing designs of "Karbate" chemical processing equipment. For six years Mr. Brauning was district office engineer where he assisted sales engineers on technical problems. For the past seven years he has been a field engineer representing National Carbon Company to the chemical processing and allied industries.

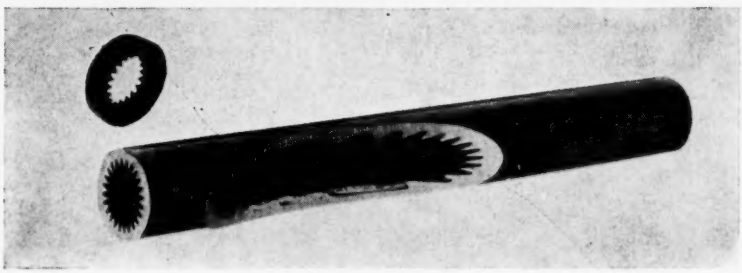
This calibre of training and experience qualify Mr. Brauning to assist in the selection, special designing and installing of carbon, graphite and "Karbate" chemical processing equipment. Call your National Carbon Sales Engineer today.

Low permeability graphite stock available from National Carbon

This low permeability graphite can be used in high temperature applications where greater degrees of imperviousness than obtained with ordinary graphite are required. The material is designated as Code 82 graphite and has a permeability in the range of 1-10 millidarcys. Field tests show this material is well suited for fused salt vessels, thermocouple sheaths and low pressure gas heaters such as those used in the heating of chlorine by the electrical resistance of the tube walls.

Code 82 graphite is available in tubes, cylinders and blocks. Its permeability is uniform and equipment can be machined or fabricated from the stock forms without impairing the degree of imperviousness. For more information contact National Carbon Company, P.O. Box 6087, Cleveland 1, Ohio.

"Karbate" Internal Low-Fin tube exchangers provide high corrosion resistance at prices comparable to carbon steel exchangers



The following comparison made by a National Carbon Field representative shows the relatively low cost of "Karbate" impervious graphite corrosion resistant heat exchangers using the newly developed internal low-fin tube.

The problem consisted of cooling 150,000 pounds per hour of a sulfonated hydrocarbon mixture from 300°F. to 100°F., using 85°F. water. Heat transfer wise, both "Karbate" impervious graphite and steel could be used. But corrosion wise, plain steel would not be considered for handling sulfonated hydrocarbons. Substituting more corrosion resistant austenitic and molybdenum stabilized austenitic stainless steel would jump the price of the metal unit two or three times that of the "Karbate" impervious graphite unit. All comparisons are based on units with carbon steel shells and floating end construction.

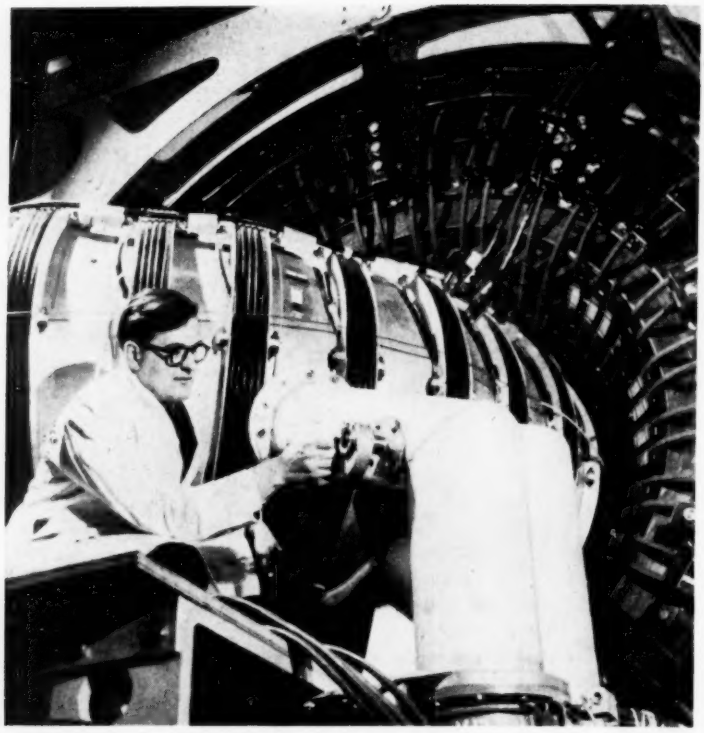
The low cost extra surface required in the low-fin design reduces the operating heat flux of the unit, and hence the temperature drop through the tube side fouling factor. This means a longer operating cycle between cleanings. Consequently, not only is the "Karbate" unit less expensive to obtain but also it is less costly to maintain.

Exchanger	Size	Area	Shell Side Pressure Drop	Tube Side Pressure Drop	Overall Coefficient	Dirt Factor	Price
"Karbate" Impervious Graphite	33" I. D. shell with 349—¾" I. D. x 16 ft. long internal low-fin tubes.	3360 sq. ft. based on I. D.	13 psig	10 psig 8 pass	69.5	.003	$16,700
Steel	45" I. D. shell with 904—1" I. D. x 14 BWG x 16 ft. long tubes.	3780 based on O. D.	13 psig	10 psig 12 pass	62.0	.003	$13,700

NATIONAL TRADE-MARK

The terms "National", "N" and Shield Device, "Karbate" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

UNION CARBIDE



BRITAIN pins hopes on torus for final proof of fusion, as . . .

PERHAPSATRON AND ZETA

Pioneer Fusion's Frontiers

Swift-moving events in Britain and the U. S. point to substantial progress in harnessing thermonuclear power.

Scientists operating Zeta (Zero Energy Thermonuclear Apparatus) at British Atomic Energy Authority's Harwell labs now think they've succeeded in wringing thermonuclear neutrons from electrically heated deuterium gas at temperatures around 5 million C.

Main components of Zeta, above, are a toroidal gas-discharge tube (3-ft.-dia. bore, 9-ft. mean dia.) containing gas under vacuum, and transversely mounted primary core of vertical transformer, about 15 ft. in diameter. Torus is copper or aluminum and, in present apparatus, is uncooled.

▶ **Repulsive Deuterons**—To fuse deuterons (deuterium nuclei), Zeta gives them enough energy to overcome repulsive forces between them.

Zeta heats gas with electrical impulses of 200,000 amp. maximum, lasting 2-5 milliseconds. Magnetic field set up causes gas to become constricted and heated still more. Gas filament (thermonuclear flame) about 4-in. dia. runs through torus core, is stabilized by interaction of two magnetic fields and kept from contacting torus walls.

▶ **U. S. Takes Two Routes** — While Britain sticks to toroidal "bottles," the U. S. is experimenting with straight and toroidal pinch tubes.

Highest temperature — 6 million C.—has been reached in whimsically-named Perhapsatron at Los Alamos, N. M. Diminutive (roughly 14-in. mean dia.) in comparison with Zeta, toroidal Perhapsatron gives only 1 million neutrons per pulse. U. S.'s larger Columbus II, a straight pinch tube, gives off 10-100 million neutrons per pulse.

Chief difficulty besetting U. S. efforts is to get pulses lasting more than a few microseconds.

Latest British reports are that within a few days, they'll begin working to reach temperatures around 10 million C.

▶ **Hurdles Ahead**—Probable conditions for commercially feasible fusion power, say Harwell researchers, is 150 million degrees C. for a period of one second. And, they add, there are a lot of tough problems to be solved before that time (10 years, according to the most optimistic observer). Number one is to prove conclusively that they have achieved true thermonuclear fusion.

Convention Calendar

American Society of Mechanical Engineers, Gas Turbine Power Div., conference and exhibit, Shoreham Hotel, Washington, D. C., March 3-6.

American Society of Mechanical Engineers, Lubrication Div., role of viscosity in lubrication, 150 E. 42 St., New York, N. Y., March 10-11.

Nuclear Congress and Trade Show, International Amphitheatre, Chicago, Ill., March 17-21.

National Assn. of Corrosion Engineers, national meeting, Civic Auditorium, San Francisco, Calif., March 17-21.

American Society of Mechanical Engineers, Engineering Management Conference, Somerset Hotel, Boston, Mass., March 19-20.

Western Petroleum Refiners Assn., 46th annual meeting, Hilton Hotel, San Antonio, Tex., March 24-26.

Society of the Plastics Industry, 15th annual Pacific Coast Section conference, El Mirador Hotel, Palm Springs, Calif., March 26-28.

HOW THE WYSSMONT CLOSED CIRCUIT DRYING SYSTEM

with Solvent Recovery

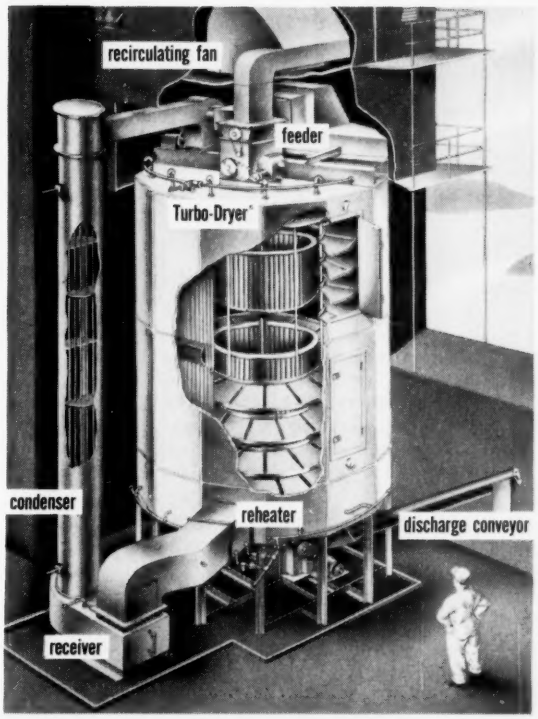
CAN IMPROVE YOUR PROCESS

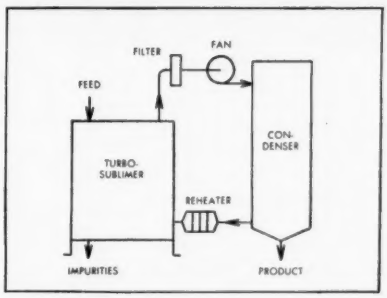
An increasing number of plants are discovering that the use of solvent instead of water, in a process which terminates with drying of a solid product, can result in these important advantages:

- **Improved quality of product because low boiling solvent permits lower drying temperature**
- **Improved washing through use of more suitable solvent**
- **Increased filter or centrifuge capacity**
- **Changing low temperature vacuum batch drying to continuous atmospheric operation**
- **Reduced drying heat requirement because of lower latent heat**

The Wyssmont TURBO-DRYER® Closed Circuit System enables you to realize these advantages *plus* the following benefits:

- **High solvent recovery**
- **Dustless, odorless and fumeless operation**
- **No loss of dust or vapor to atmosphere**
- **Operation at atmospheric pressure**
- **Safe operation with inflammable solvents through efficient use of inert gas as drying medium**





Entrainer Sublimation — another application of the Wyssmont Closed Circuit System

FOR FULL DETAILS applying to your particular process, write to: Wyssmont Company, Inc., 42-01D 27th Street, (Bridge Plaza South), Long Island City 1, N. Y. Representatives in principal cities.

TURBO DRYER

WYSSMONT COMPANY, INC.

DRYING & PROCESS ENGINEERS

The Wyssmont TURBO-DRYER® is applicable to continuous drying with SOLVENT RECOVERY, continuous purification by SUBLIMATION, continuous SOLID-GAS REACTIONS, and as a DRYER-COOLER.

New Benzene Unit Marks Petrochemical Drive

New 30-million-gal./yr. high-purity benzene unit at Humble Oil & Refining Co.'s Baytown, Tex., refinery marks a big step in firm's petrochemical expansion program. Unit was engineered and built by Badger Mfg. Co. Feedstock for the plant, one of the largest of its kind in the world, will come from nearby hydroformer. Early this year, Humble also announced expansion of paraxylene unit to 66 million lb./yr.

Waste Brine Gives Cool Process Water

Problem: What's an economical way to get 63 F. cooling water in an arid, sunny area where conventional cooling towers can only bring water down to 86 F.?

Answer: If you have a handy source of steam and concentrated brine, you can use the scheme worked up for Dead Sea Bromine Co. by David Wittenberg, consulting engineer in Haifa, Israel.

Process depends on evaporative cooling of water under vacuum and then "condensing" the vapors in warm brine. Water vapors are actually absorbed, because brine's vapor pressure is less than that of the water vapor.

Recycled cooling water at 68 F. flashes into the evaporating chamber, while a steam ejector keeps the whole system under vacuum. Part of the water vaporizes, cooling remainder down to 63 F. Vapors pass into "condenser" and are absorbed in concentrated carnallite ($KMgCl_3 \cdot 6H_2O$) brine at 86 F. This liquor is waste product from bromine processing.

At 86 F., vapor pressure of brine is 12 mm. Hg, the same as water at 59 F. There's an absorption driving force of about 2 mm. Hg between warm brine and cool vapors.

Operating cost of this system (including capital cost) is much less than for a cooling tower of similar capacity—160,000 BTU./hr.—yielding only 86 F. water.

Oil Refinery Operates Inside Giant Computer

Humble Oil & Refining Co.'s Baytown, Tex., refinery is now running — in model form — inside a giant IBM 705 computer.

Mathematical models of various process units and of refinery as a whole have been constructed and put on magnetic tape. This tape is the "feed" for the electronic data processing machine.

These models are being used to explore the effect of possible changes in operating conditions. Products and product quality can be determined in greater detail than with previous methods.

Computer will also be used in design of new operating units.

For some of the most critical units, economic evaluations are included in the calculating procedure and computer determines optimum levels of temperature, flow rates and other key variables.

This is the second 705 in use at Baytown. The other is used mainly for accounting.

News Briefs

Glycerine, acrolein: Shell Chemical Corp. is building two new multimillion-dollar plants at Norco, La., one to make acrolein and another to convert some of it to glycerine at a 35-million-lb./yr. clip.

Nylon: Du Pont has swung on stream at Richmond, Va., a new multimillion-dollar plant to produce heavy-denier nylon for use in tire cord and industrial products.

Methacrylate: Hercules Powder Co. has postponed indefinitely its plans to build a plant at Louisiana, Mo., to manufacture methacrylate.

Trimethylolpropane: Celanese is turning out trimethylolpropane at its new 10-million-lb./yr. plant at Bishop, Tex. Firm also announced price reduction from 41 to 39¢/lb. in truckload quantities.

Cellulose, wood pulp: Rayonier has opened its second 100,000-ton/yr. plant at Jesup, Ga., to turn out chemical cellulose and wood pulp. New plant investment: $25 million.

Polyethylene: Imperial Chemical Industries of Australia and New Zealand has swung on stream a new $5-million polyethylene plant at Sidney, New South Wales, is already announcing a $2.5-million expansion plan to double capacity.

for the most efficient recovery of platinum metals . . .

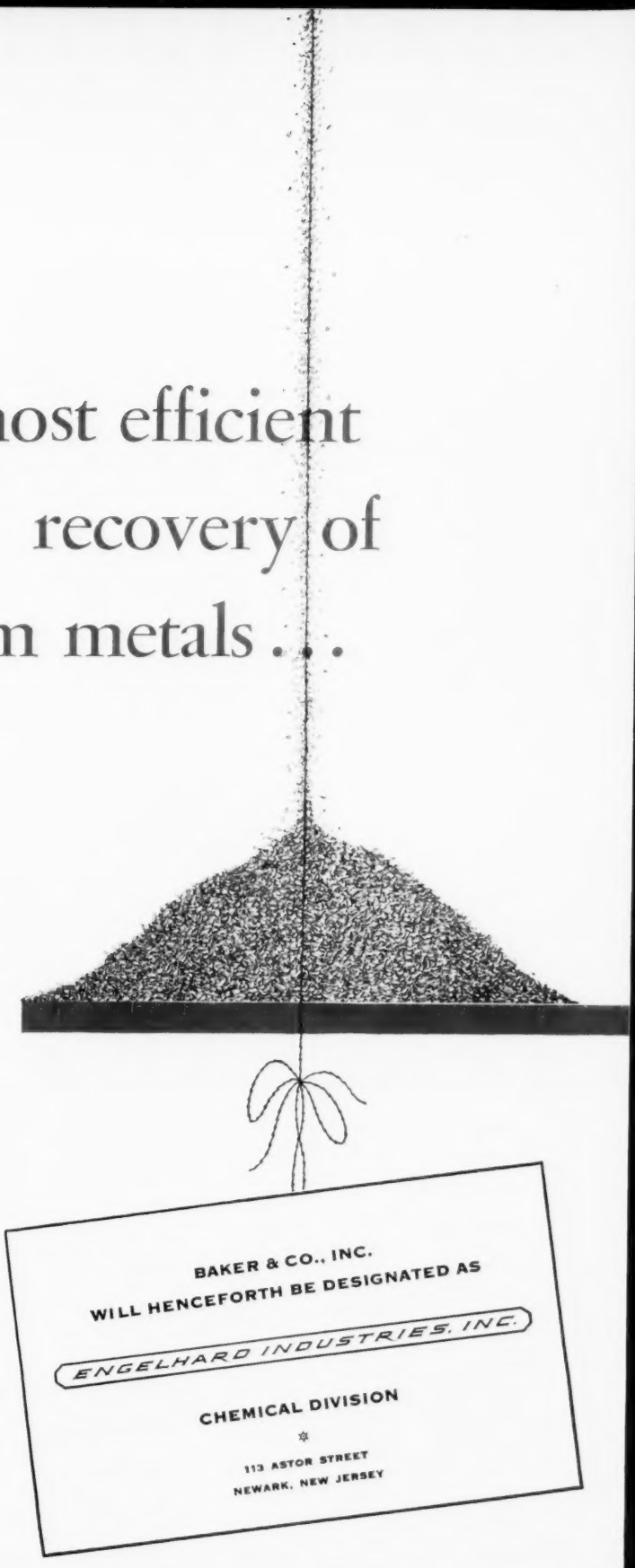
Here, specialized knowledge, experience and facilities combine to provide the chemical industry with a most efficient service for maximum recovery of platinum metals from spent catalyst.

Baker procedures recover and deliver 100% of assayed platinum metal content. Plants, personnel and equipment are geared for prompt recovery.

Baker plants are also prepared of course to manufacture platinum metals catalyst in any required concentration of metal, in the form and on the carrier best suited to your production.

Thus, to maintain an efficient, uninterrupted cycle of use, recovery and re-use—*place the problem with Baker & Co.* Detailed information is available upon request. Do call us.

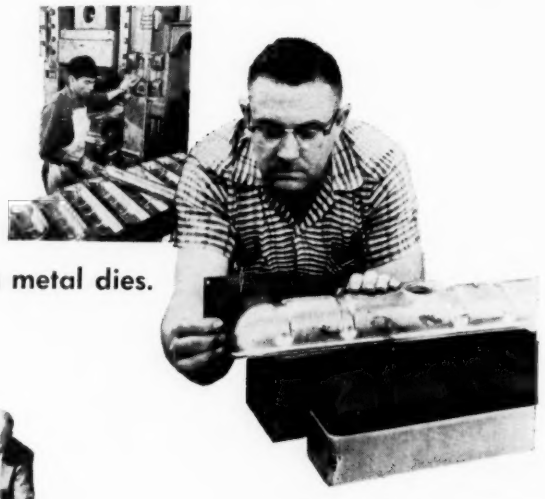
All data of confidential nature are of course treated accordingly.



THE WORLD'S LARGEST WORKERS AND REFINERS OF PRECIOUS METALS

New Reinforced Epoxy

takes more jobs away from metal dies.



After 130,000 stampings of .025-in.-thick brass, parts made by plastic die still pass quality inspection.

Delivery time for plastic die for steel stamping, 5 wk.; steel die would take 10 wk.

Plastic Tooling Moves Into Longer Runs

Of metal-fiber-laced epoxy, plastic tooling is no longer tied to short production runs.

Present plastic tooling is lighter, cheaper, quicker to make than standard metal dies. Now new metal-fiber-reinforced epoxy composition for tooling adds outstanding impact strength, thermal conductivity and machinability to advantages plastics materials can offer tool and die makers.

Result is that plastic applications formerly limited to prototype and low-production metal-forming dies now extend to medium production-run metal forming. Though the new reinforced epoxy will cost more than a simple casting of compounded epoxy, its unique properties will also extend the new reinforced epoxy's uses to those where conventional plastic materials are marginal.

Called Epoxy-Alloy, the term refers not only to new reinforced plastic material, but also to a method for effectively using this material. An Epoxy-Alloy tool or die is a mass casting, made by a pressure process, consisting of a heat-resistant epoxy system reinforced with metal or glass fibers. For best performance, a technique has been developed for surfacing the pressure-cast core of an Epoxy-Alloy die with an epoxy face coat reinforced with flocked chopped metal-fibers.

Depending on whether metal fiber or metal and glass fiber reinforcement are used, the identification of the new composition will vary as follows:

Epoxy-Alloy ES — An epoxy mass casting reinforced with steel fiber and surfaced with an epoxy steel-fiber-flocked face coat.

Epoxy-Alloy EG-SF—An epoxy mass casting reinforced with glass fiber and surfaced with an epoxy steel-fiber-flocked face coat.

Epoxy-Alloy EA — An epoxy mass casting reinforced with aluminum fiber and surfaced with an epoxy aluminum-fiber-flocked face coat. This Epoxy-

DU PONT

CHEMICAL ENGINEERING NEWS

LATEST PROPERTY AND APPLICATION DATA ON TEFLON® fluorocarbon resins

O-rings of TEFLON® in stainless steel faucet provide "universal" chemical service

TFE-fluorocarbon resins

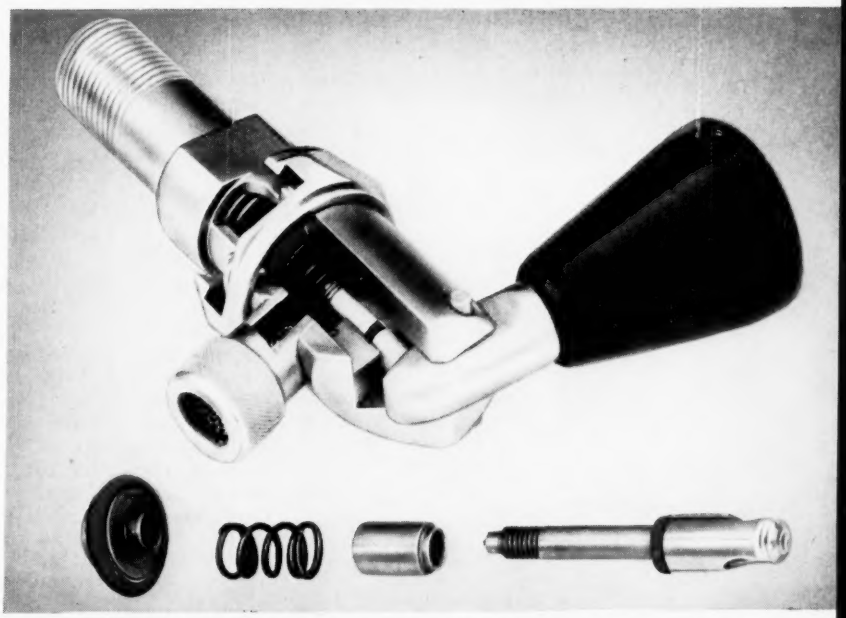
Stainless steel fittings use seals of TEFLON® to stop costly leakage

Seals of TEFLON TFE-fluorocarbon resins make effective pressure- and vacuum-tight closures in stainless steel fittings. They can be disassembled and reassembled repeatedly without damage or leakage, because of the toughness and recovery properties of the resins.

Sealing devices made of these resins are often specified even when their outstanding chemical inertness and thermal resistance are not required. For instance, gaskets of TFE-fluorocarbon resins have no tendency to stick to flanges, due to their "waxy" surface. Mechanical properties of the seals are comparable to those of the best grades of rubber-bonded compressed asbestos. Packings take advantage of the extremely low coefficient of friction of the TFE-fluorocarbon resins . . . shaft torque is greatly reduced and mechanical efficiency increased.

TEFLON TFE-fluorocarbon resins are rated for use up to 500°F., are inert to virtually all chemicals and solvents. Maintenance and replacement costs are often greatly reduced by their use.

("Koncentrik" fitting shown here, using seals of TEFLON TFE-fluorocarbon resins, is made by the Special Screw Products Company Bedford, Ohio.)



ONLY O-RINGS of TEFLON TFE-fluorocarbon resins could make this a truly all-around chemical faucet. The rings withstand any chemical attack that the faucet's stainless steel body can resist—including the highly corrosive effects of rocket fuels. (Dispensing faucet by ECO Engineering Co., Newark, N. J., O-rings of TFE resins by Halogen Insulator & Seal Corp., Franklin Park, Ill.)

Stainless steel and TEFLON TFE-fluorocarbon resins form a natural team, as the two applications on this page prove. Both will resist high temperatures and the action of chemical corrosives.

In the case of the chemical dispensing faucet, a vital part was re-designed to take advantage of the properties of TFE-fluorocarbon resins thereby increasing the variety of chemicals it could safely handle. Originally, the stem was fitted with conventional O-rings which could be stretched, slipped down the shaft and snapped into place. Since the rings of TFE-fluorocarbon resin wouldn't stretch as much as other materials without deformation, the stem was re-designed as shown above, providing an economical way to mount them.

The rings of TFE-fluorocarbon resin give the faucet a universality it would not otherwise have. Unlike other polymers, TEFLON resins are fluoro-saturated, do not discolor and embrittle when exposed to hydrazine and other critical fluids.

Whether in initial design or replacement, it will pay you to use parts made of TEFLON resins. For quick reference to processors of TEFLON TFE-fluorocarbon resins, see the Du Pont Plastics listing in Classified Telephone Directories. Technical properties and many interesting end-uses are described in the literature you will receive by writing to. E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Room 73, Du Pont Building, Wilmington 98, Delaware.

In Canada: Du Pont Company of Canada (1956) Limited, Box 660, Montreal, Quebec.

TEFLON®

is a registered trademark

TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed herein. This registered trademark should not be used as an adjective to describe any product, nor should it be used in whole, or in part, as a trademark for a product of another concern.

Alloy composition is designed for applications requiring high thermal conductivity, such as heated matched molds, and the like.

To date, approximately seventy Epoxy-Alloy dies have been put into commercial operation. Thirty-five dies for a military project were built in 15 weeks at a cost of $250,000. Conventional metal tools, it is reliably estimated, would have required up to 18 months of tooling time at an approximate cost of $2 million.—**Bakelite Co., 260 Madison Ave., New York, N. Y.** 74A

Page number is also Reader Service Code Number

Metal-fiber-laced epoxy for more durable plastic tooling..... 74A
Nitrile rubber gains ozone resistance..... 76A
Resinous polyols to make caustic resistant coatings..... 76B
Polyester-based transparent thermoset resists 280 to 300 F.... 76C
Polyester foaming resins add strength, lower cost of urethane 76D
New polyether series for urethane making..... 76E
Isocyanate variation gives urethanes better heat resistance... 76F
Urethane foam production from a new quarter..... 76G
Azelaic acid made in new high purity..... 78A
Linear polyethylene goes into clear films..... 78B
New antiknock, first since tetraethyl lead..... 78C
Diethylene glycol in new grade for making polyesters..... 78D
Pentaerythritol now comes in pellets..... 78E

Nitrile Rubber

The first with ozone resistance.

Compounds of new Hycar 1072 nitrile rubber are reported to be unaffected by ozone during extended test periods, even when the compounds are soaked in hot oil before exposure to ozone.

The compound also has superior oil resistance, good flexibility, high strength and exceptional resistance to abrasion and oxidation.

Suggested applications include electrical insulation, especially near ozone-producing spark discharges, and fabric coatings for both indoor and outdoor uses. Rubber parts which are under extension stress during use are more likely to be attacked by atmospheric ozone than are those which are not under stress. Therefore, Hycar 1072 should do well in finished parts which are likely to be under tension for long periods.—**B. F. Goodrich Chemical Co., 3135 Euclid Ave., Cleveland, Ohio.** 76A

Resinous Polyols

Intermediate for surface coatings.

A new intermediate for surface coatings, resinous polyol X-450, is now being marketed in development quantities. A hard, colorless solid, it has an average of five to six primary hydroxyls per molecule. Ideally, its chemical structure may be regarded as poly (1-phenyl, 3-hydroxymethyl butene).

Esterifications can be carried out readily with excellent retention of the original good polyol color. Surface coatings made with the material are said to feature good resistance to caustic.—**Shell Chemical Corp., Market Development Dept., 50 West 50th St., New York 20, N. Y.** 76B

Transparent Plastic

Unlike older thermosets, it holds shape in heats of supersonic aircraft.

Sierracin 880 is a new high-temperature plastic developed for canopies, windows etc. in aircraft that are operating up around the heat distortion point of materials now in use. It is a cast, polyester-base, transparent, thermosetting material that can be used for aircraft enclosures that operate at surface temperatures as high as 280 to 300 F.

Unlike many of the other thermosetting plastics which retain a tendency to return to the shape in which they were cast when subjected to high temperatures, 880 is supplied in partially cured condition. Cured after final forming, it holds this shape until it chars.

Planes which might now use glass windows because plastics won't take the friction heat they generate, would save 40 to 50 lb. if they used 880.—**Sierracin Corp., 1121 Isabel St., Burbank, Calif.** 76C

Urethanes

Quartet of developments: new polyesters, polyethers, isocyanate, new foam manufacturer.

A new series of unique low-cost polyester foaming resins are said to possess superior characteristics for the manufacture of urethane foamed products.

The resins are known as Selectrofoam Resin 6207, for flexible foamed products, and Selectrofoam Resins 6004 and 6005, for rigid products.

The flexible foaming resins provide, at reduced cost, excellent load-carrying capacity at low densities, higher resilience, good freeze resistance and a soft feel. Foam is manufactured by a one-shot process, no pre-polymer required.

The rigid resins 6004 and pre-polymer 6005 are said to provide a very tough, rigid foamed structure with unusually good adhesion for panel fabrication to other materials such as metals, some plastics

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MALEIC ANHYDRIDE TABLETS
are so
economical and easy to use!

As the principal producer, National Aniline's fully-integrated volume output and fast deliveries from our strategically-located Moundsville plant expedites your production and minimizes your inventory.

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Akron Atlanta Boston Charlotte Chattanooga Chicago Greensboro
Los Angeles New Orleans Philadelphia Portland, Ore. Providence San Francisco Toronto

and other construction materials.—**Pittsburgh Plate Glass Co., 632 Fort DuQuesne Blvd., Pittsburgh 22, Pa.** **76D**

Though first commercial urethane polymers were based on the reaction of isocyanates and polyesters, low-cost polyethers are beginning to make a strong bid for the market. A new series has just been introduced which, according to manufacturer Union Carbide Chemicals, makes it possible for urethane makers to prepare a broad range of prepolymers to meet the most exacting requirements for flexible foams.

These new intermediates are propylene oxide addition products of 1,2,6-hexanetriol, trademarked Niax. Four polyethers, varying in hydroxyl number from 42 to 240, corresponding to molecular weights from 4,000 to 700, are available.

Niax triols can be used alone or in combination with a polypropylene glycol. Increasing the amount of triol in formulations increases rigidity of resultant foams. Highest molecular weight product will probably find use in softest foams, lowest molecular weight in semi-rigid foams. It is interesting to note that as Union Carbide Corp.'s chemical company division is introducing these new polyethers, its Bakelite Co. division has announced its withdrawal from the manufacture and sale of polyester resins. Chemical company division does make polyester raw materials. —**Union Carbide Chemicals Co., 30 East 42nd St., New York 17, N. Y.** **76E**

Development emphasis in the urethane field has been primarily on the resin rather than the isocyanate component of the polymers. Now Carwin Polymer Products has come up with an isocyanate variation said to improve the physical properties of foams at elevated temperatures.

It is polymethylene polyphenylisocyanate, trade-named PAPI. PAPI-based rigid foams are said to retain 70% of their room-temperature strength at temperatures as high as 400 F. with a shrinkage of only 2%. Urethanes based on conventionally-used tolylene diisocyanates become unserviceable at 200 to 250 F.—**Carwin Polymer Products, Inc., North Haven, Conn.** **76F**

Scott Paper Co. has announced that it will manufacture and market a new type of urethane foam for insulation, cushioning, filtration and other household and industrial uses. Called Scottfoam, it is the first product the company will manufacture that is totally unrelated to the paper industry.—**Scott Paper Co., Chester, Pa.** **76G**

Azelaic Acid

Heated 1 hr. in test tube to 200 C., no degradation.

Esters produced from a new high purity azelaic acid have improved heat stability and corrosion inhibition qualities. More specifically, the esters are aliphatic diesters and have been found useful as basic components of high temperature lubricants used in jet engines and other applications where extreme operating conditions are encountered.

The new azelaic acid intermediate has a total dibasic acid content of over 99.0%. This high purity form of the 9-carbon acid is now being produced on a pilot plant basis.—**Armour & Co., 1355 West 31st St., Chicago, Ill.** **78A**

BRIEFS

Linear polyethylene as a clear film has just been introduced. Tough, resistant to moisture, greases and gases over a wide temperature range, and relatively low cost, it is expected to challenge cellophane and cellulose acetate in the packaging field.—**Phillips Petroleum Co., Bartlesville, Okla.** **78B**

Antiknock agent, said to be the first potentially commercial product since the introduction of tetraethyl lead, has been covered by patent Nos. 2,818,416 and 2,818,417. The specific compound which is being made available to oil companies for their evaluation is a derivative of cyclopentadienyl manganese carbonyl and has been designated AK-33X. — **Ethyl Corp., New York, N. Y.** **78C**

For polyester and polyurethane manufacture, new grade of diethylene glycol offers narrow boiling range which demonstrates produce purity, controlled hydroxyl content which assured uniform performance, low ethylene glycol content of give polyesters more uniform viscosity. — **Union Carbide Chemicals Co., 30 East 42nd St., New York, N. Y.** **78D**

Pentaerythritol, technical grade, has been made available in pellet form for the first time. Pellets are said to eliminate dusting long asociated with technical pentaerythritol, to effect easy pouring and dissolving.—**Canadian Chemical Co., Ltd., Montreal, Canada.** **78E**

For More Information . . .

about any item in this department, circle its code number on the

Reader Service

postcard inside the back cover

Emery NEWS

WEIGHING SYSTEM

BIN, TANK AND HOPPER EDITION No. 7

Covering design, development and application data on Emery Weighing Systems for industrial applications

ENGINEERS AT PARKE, DAVIS & CO. ADOPT NEW CONCEPT OF TANK WEIGHING IN BROMINE PROCESSING PLANT

SPECIAL CONDITIONS IN BROMINE STORAGE AND WEIGHING AREA PROMPTED SELECTION OF EMERY LOAD CELLS.

In selecting weighing apparatus for a bromine storage and process system at its Holland, Michigan, plant, Parke, Davis & Company engineers were faced with an interesting set of factors which led to the eventual choice of a relatively new concept in process control . . . tank weighing instead of measuring tank contents. Emery Hydraulic Load Cells were selected to handle the weighing job.

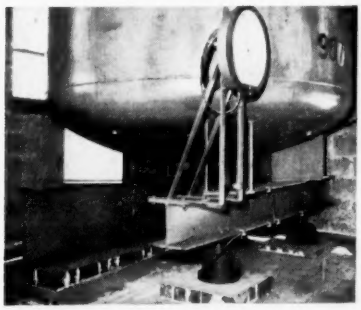

Fig. 1. Close-up view of the bromine storage tank showing how Emery Load Cells support the front end while the back end is carried on a 21" I-Beam.

The process required weighing of bromine in both storage and in process. Liquid bromine is pumped from the storage tank to an elevated intermediate tank where the required amount for use in the process is weighed. Excess bromine in the weigh tank is drained back to the storage tank. The system is vented through a fume scrubber.

The corrosiveness of bromine liquid and vapor dictated that an external gauging system be used. The lead lining of the storage tank precluded the use of gauging systems using radioactive sources. Compressed air of the necessary pressure was not available for weighing equipment using air as a motive force. The possible damage to beam scales by the corrosive action of chemicals and fumes was a deterrant to the use of this equipment. Equipment utilizing an electrical signal would have to be explosion-proof or remotely located from the hazardous area. Thus, Emery Hydraulic Load Cells were selected.

Two EC-30 Emery Cells support the storage tank in front; the back end being carried on a 21" I-Beam. The Emery 16" Indicator is set directly in front of the tank.

The weigh tank is suspended on a sling and linked to an overhead support through another EC-30 Emery Load Cell. A 21" dial indicator is located at floor level at which point the pump control is operated to fill the weigh tank with the required amount of liquid bromine which is then forwarded to the point of processing.

In specifying Emery Load Cells in this bromine weighing application, Parke, Davis & Company found that the peculiar conditions surrounding this particular installation were easily met by an Emery tank weighing system.

Fig. 2. Emery Dial Indicator for weigh tank is conveniently located above pump control. Operator can fill weigh tank to exact weight, then shut pump off.

If you face conditions of a similar nature . . . or if you have a tank weighing problem of any kind, our engineers will gladly study it and make recommendations. Be sure to send for our Bulletins 561 and 571.

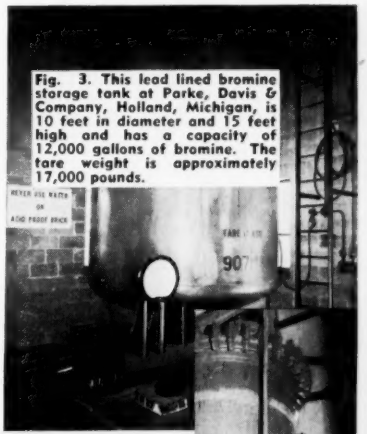

Fig. 3. This lead lined bromine storage tank at Parke, Davis & Company, Holland, Michigan, is 10 feet in diameter and 15 feet high and has a capacity of 12,000 gallons of bromine. The tare weight is approximately 17,000 pounds.

Fig. 4. The weigh tank is 4 feet in diameter and 6 feet high. It is glassed steel and has a capacity of 100 gallons of bromine. Tare weight is 800 pounds.

Tank Weighing Data

Our Bulletins 561 and 571 are filled with technical data on tank, bin and hopper weighing; the arrangement of cells and instrumentation; and the new approach to tank weighing through the results you need. If you have not received your copies send for them today.

PRECISION SINCE 1872 — THE A. H. EMERY CO. — FORCE MEASUREMENT

THE A. H. EMERY COMPANY

Pine Street • New Canaan, Conn.

DEVELOPMENTS . . .

PROCESS EQUIPMENT

EDITED BY C. S. CRONAN

Equipment Developments

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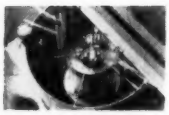
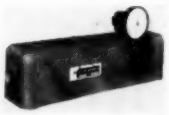


Portable reactor core 80A
achieves self-sustaining reaction in first test.

Precision specialties 82B
now available from new special service facility.

Air springs on shaker 82C
screens isolate 99% of all vibration.

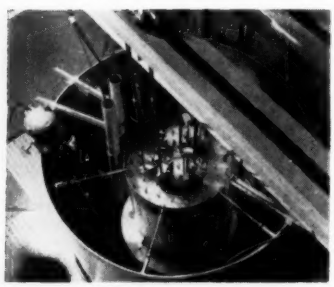


Pressure equipment 84B
supply now includes tools for 1/10 million psi.

Preheater insures steady fuel supply. . . . 80B
Mobile substation aids maintenance. 82A
Doyle scrubber now on open market. 84A
Bin lifter attachment hoists Sealdbins. 84C
Portable shower gives field protection. . . . 86A
Tentative pump standard memo available. . 86B

Plastic diaphragm valve works at 300 F. . . 86C
Three-way gun applies glass laminates. . . . 86D
Liquid-ring pump for transfer service 86E
Plastic air scrubber removes acids. 86F
Ceramic insulation withstands 2,000 F. . . . 86G

For more details use Reader Service Card



Portable Reactor

Successful tests bring commercial use near.

Recent testing of the core of Martin's Package Power Reactor met with prompt success. A self-sustaining nuclear reaction was achieved on the first try at the Baltimore zero test facility. Manufacture and testing of the core was conducted under contract with the Atomic Energy Commission.

Core loading for the test consisted of 700 steel-clad fuel elements of enriched uranium. Experimentation with individual elements in the AEC's Materials Testing Reactor at Idaho Falls, Idaho showed 41.7% burnup, with no evidence of deterioration or blistering.

About 9 × 9 × 30 ft. in size, and weighing from 6 to 15 tons, the portable reactors can be readily transported anywhere by cargo aircraft. The self-contained units are adaptable to temperate, tropical or arctic climates.—**The Martin Co., Baltimore, Md.** 80A

Preheater

Lowers pump loads to insure steady fuel supply.

Designed to lower wintertime pumping loads when handling heavy heating oils from bulk storage, the Hot-Spot preheater helps to insure constant fuel supply to the burners, regardless of ambient temperature.

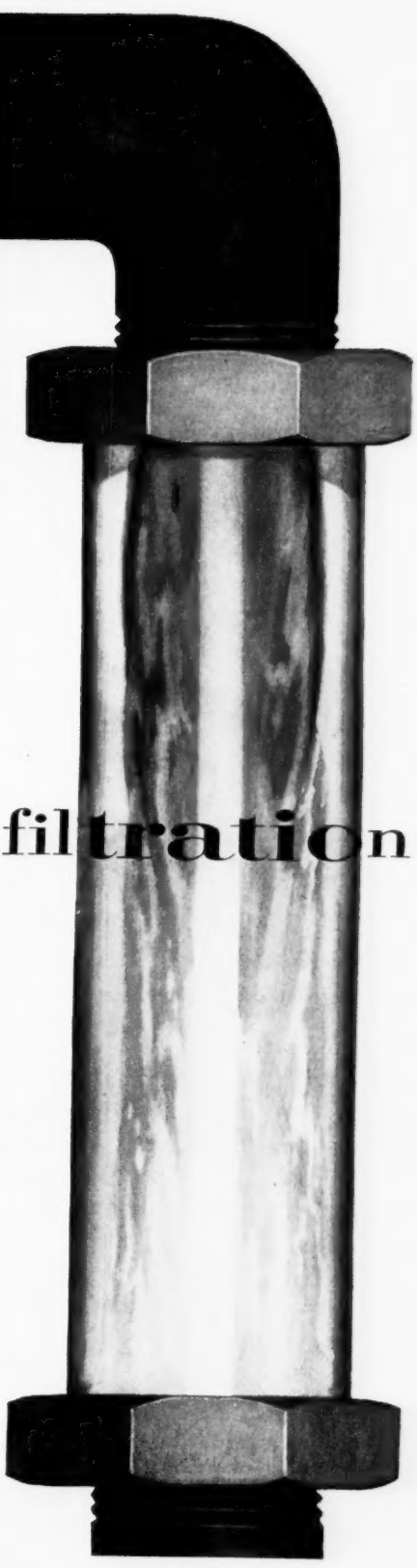
Lowered into tanks through the manhole, it consists primarily of a shell-and-coil assembly and a flow accumulator. Suction line to the pump passes along the centerline of the heating coil.

Heating medium, either steam or hot water, reaches the coil via furnished piping. The accumulator directs oil flow en route to pump suction over and through coil loops. In this way, no heating capacity is wasted on the bulk of material in the tank.

Although designed primarily for heavy fuel oils, it should simplify wintertime pump-down of many other fluids in bulk storage.

Hot-Spot is available in two sizes—one for manholes 16½ in. and larger, the other for those below.—**Rempe Co., 340 North Sacramento Blvd., Chicago 12, Ill.** 80B

Don't let dirty process water spoil product quality



Clarify it with Celite filtration

PROCESS WATER which contains colloidal color and suspended solids may seriously affect your product quality, increase costly rejects and cause customer complaints.

With Celite* filtration, you're assured of clean, clear water whether it is used as an ingredient of your product or is intimately associated with its processing. In addition Celite prevents fouling of resin beds in softeners and demineralizers.

Celite removes more suspended solids than other types of clarification—even amoebae and algae and most bacteria. It operates at fast flow rates with any conventional pressure filter. It comes in 9 different grades for precise clarity control. And it is low in cost.

A Celite engineer will be glad to study your water problem and offer his no-obligation recommendations. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

JOHNS-MANVILLE
Celite Diatomite Filter Aids

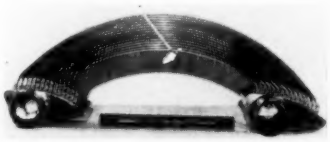
Mobile Substation Temporarily Shoulders the Load

Inspection and maintenance of permanent substations is no problem at Gulf Oil's Port Arthur, Tex., refinery. This sub-on-wheels can be quickly hauled anywhere in the 4-sq.-mi. refinery area to temporarily take over for almost any of the 140 transformer banks on the line. The General Electric unit—containing a three-winding transformer, switchgear and lightning arresters—can be hooked up five different ways to replace substations ranging up to 3,000 kva. —General Electric, Power Transformer Department, Pittsfield, Mass. 82A

Equipment Cost Indexes

	Sept. 1957	Dec. 1957
Industry		
Avg. of all	225.0	229.2
Process Industries		
Cement mfg	216.6	220.7
Chemical	226.6	230.4
Clay products	210.4	214.4
Glass mfg	214.0	217.6
Paint mfg	217.4	221.6
Paper mfg	218.3	222.0
Petroleum ind	222.0	226.3
Rubber ind	224.8	229.1
Process ind. avg	223.7	227.0
Related Industries		
Elec. power equip	229.8	232.9
Mining, milling	228.0	231.8
Refrigerating	254.0	258.9
Steam power	212.8	216.9

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124–6 for method of obtaining index numbers; Feb. 24, 1958, pp. 143–44 for annual averages since 1913.



Precision Specialties

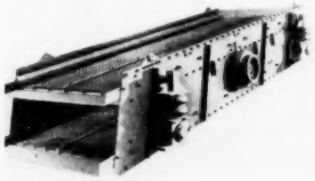
Made-to-order equipment tailored at new facility.

Utilizing up-to-date techniques of fabrication and quality control, Griscom-Russell's new special-service facility can turn out precision products ranging from a few ounces in weight to 60 tons.

A unique combination of tube-bending equipment, modern methods of welding, and a vertical-pit furnace capable of brazing 20-ft.-long constructions in a hydrogen atmosphere enables unrestricted working of alloys like Inconel and Monel, Hastelloy X, Croloy, and both austenitic and ferritic stainless steel.

Diverse inspection techniques, including ultrasonics, radiation, and halogen-leak detection are available for keeping tabs on quality.

Typical output includes fan-induced-draft heat exchangers, ballistic missile components and nuclear reactor instrumenlation. The illustration above, depicting a specialty heat exchanger constructed of tubes having an O.D. of only $\frac{3}{16}$ in., is indicative of attainable quality.—**The Griscom-Russell Co., Massillon, Ohio. 82B**



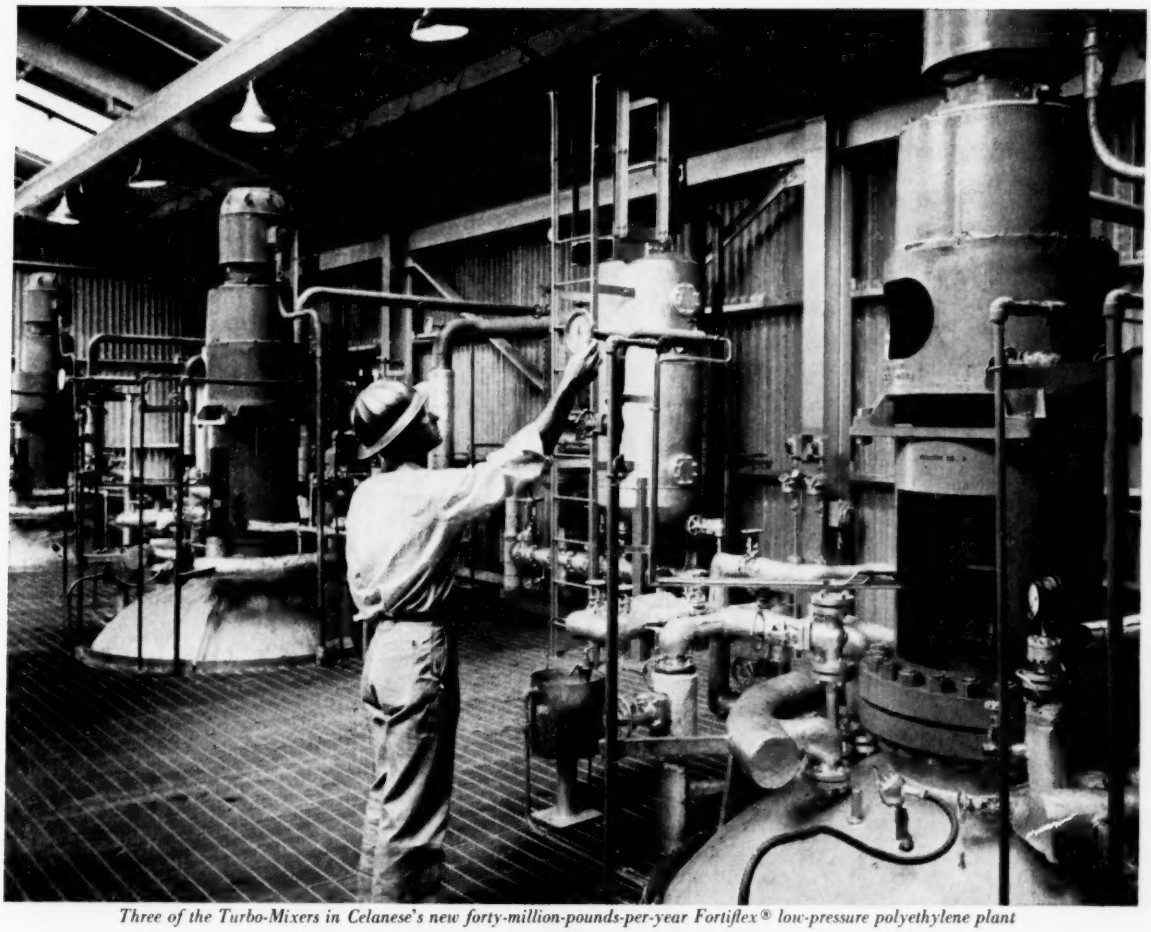
Air Springs

Cut vibrating-screen noise and maintenance.

Vibrating screens mounted on air springs are now available from Allis-Chalmers. Suspension on these columns of air makes it possible to isolate 98-99% of all vibration. The new feature also reduces maintenance costs and quiets operation.

Constructed of nylon cord and a special high-strength, heat-resistant compound, the springs are inflatable from either air line, pump or bomb. Alteration of spring air pressure permits quick adjustment to compensate for feed weight changes. This makes it possible to keep a level deck when handling high-moisture materials.

Air springs are available on all new floor-mounted screens greater than 5 × 12 ft. in size. Field installation of the springs on floor-mounted A-C screens is possible if the existing units have dual steel-spring arrangements on each corner.—**Allis-Chalmers Mfg. Co., Milwaukee 1, Wis. 82C**



Three of the Turbo-Mixers in Celanese's new forty-million-pounds-per-year Fortiflex® low-pressure polyethylene plant

for critical low-pressure polyethylene reactors,

CELANESE CHOOSES TURBO-MIXERS

The *formative reaction* is a critical step in the manufacture of Fortiflex®—now being made in the brand-new forty-million-pounds-per-year low-pressure polyethylene plant of the Plastics Division of the Celanese Corporation of America.

For this reaction, Celanese engineers had to have a mixer that would exactly maintain the correct mixing environment. For this reliability in design and performance, Celanese selected Turbo-Mixers. The above-pictured reactors are in the full scale plant (not the pilot plant). Turbo-Mixers serve in many operations in this and other polyethylene plants.

Turbo's 45 years of experience in design . . . Turbo's record of dependability . . . and Turbo's single-source responsibility make the difference. If you're in the process of selecting or specifying mixing equipment, call on Turbo. You'll find . . . *it pays to plan with General American.*

Write for descriptive bulletins.

TURBO-MIXER GENERAL AMERICAN TRADE MARK

TURBO-MIXER DIVISION

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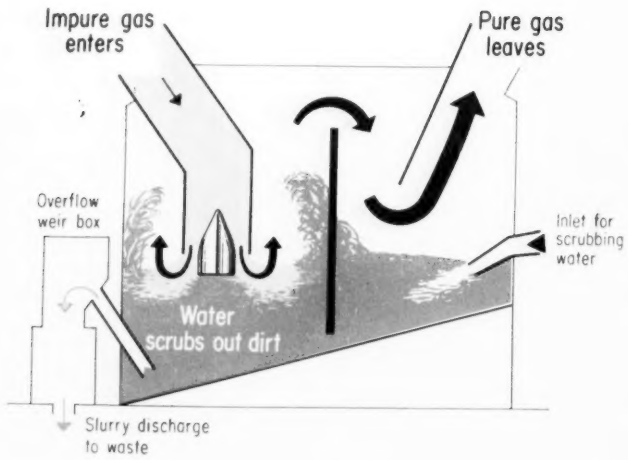
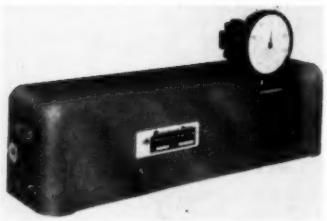


Mining Company Releases Doyle Scrubber to Industry

Consolidated Mining and Smelting Co.'s highly successful Doyle scrubber is now available for general industry use, except for phosphates, through Western Precipitation Corp. Reported to provide higher efficiencies than are economically possible with spray towers or wet cyclones, scrubber has been used with dust loadings up to 1,000 milligrams/cu. ft. at temperatures as high as 1,660 F. Unit requires 1-2 gal. water/1,000 cu. ft. of gas, 2.2-3.0 hp./1,000 cfm. Capacity ranges from 500 to 36,000 cfm. per unit.—Western Precipitation Corp., 1000 West Ninth St., Los Angeles 54, California. 84A



Pressure Equipment

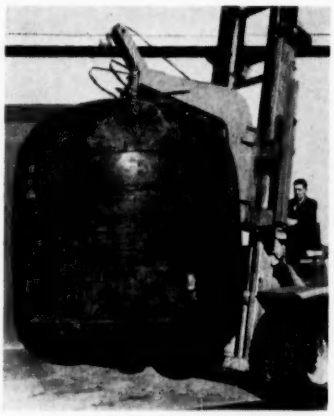
New additions join family of high pressure gear.

Three new tools from Aminco will soon supplement industry's store of process tools for missile-age pressures—a 100,000-psi. gage (pictured above), an alarm to detect hydrocarbons in compressed gas at 100,000 psi., and fast-assembly valves and fittings that withstand 10,000 psi.

Sensing element of the newly designed extreme-pressure gage is a shielded, heavy-walled eccentric tube that is straight at atmospheric pressure. Additional pressure applied to the end of the tube causes it to curve. Movement is detected and indicated on a precise dial gage which can be read to the nearest 250 psi. Designed for maximum safety, the gage comes equipped with a super-pressure female adapter for ¼-in. heavy-walled tubing.

The alarm, now being used extensively in the missile development program, will root out the presence of as little as 0.000012 gm. of atomized oil per liter of air. Operating on the "dark field" illumination principle, the device consists essentially of a photomultiplier microphotometer, a mercury-vapor lamp, and a windowed pressure vessel. The photometer detects light scattered from gas-stream impurities, and actuates a warning device or controller.

Connection of the stainless steel, superpressure, fast-assembly valves and fittings requires no threading or beveling. Tubing is merely cut to desired length and inserted into the tube where it is securely locked by a nut and internal sleeve. With proper care, joints can be made and broken many times without impairing efficiency.—**American Instrument Co., Inc., Silver Spring, Md. 84B**



Bin Lifter

Enabies lift truck to handle rubber Sealdbins.

Yale & Towne now offers an attachment that enables its G-3 line of 15,000-20,000-lb.-capacity lift trucks to handle U. S. Rubber Co.'s Sealdbin flowable-solids containers.

Designed for use with standard 30-cu.-ft. Sealdbins or smaller, boom hook mounts directly on G-3 carriage. Hairpin guides on either side of the hook facilitate engagement with lifting eye on Sealdbin. A hydraulic, power-operated winch built into the attachment picks up collapsed, empty containers.

Lifting range permits use of attachment for loading all types of gondola cars. At full height, the bottom of a 300-cu.-ft. Sealdbin will clear the side of the highest standard truck trailer by 10 in.—**The Yale & Towne Mfg. Co., 1100 Roosevelt Blvd., Philadelphia 15, Pa. 84C**

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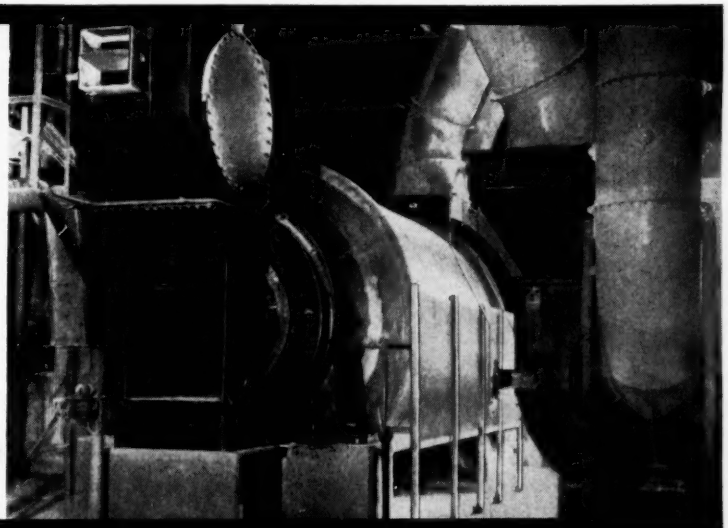

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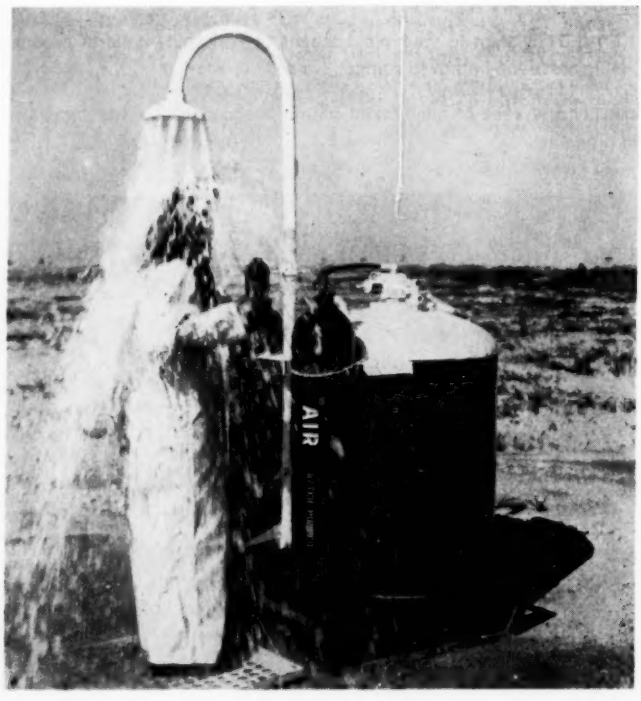

Portable Decontamination Shower Makes Big Splash

Just step on the treadle and harmful materials are flushed away. Originally designed for quick removal of liquid rocket fuels from American missilemen, this Army-developed portable field shower is now produced for private industry. Made by the Lofstrand Co., which has just completed a 2,000-unit government order, the shower consists of a 100-gal. insulated water tank, feeder line, spray head and treadle mechanism—all mounted on a skid base. Aluminum construction holds the weight down to 570 lb. Two cylinders of compressed air provide 45-psi. pressure.—**The Lofstrand Co., Rockville, Md. 86A**

Pump Standard

Now available in memo form to interested parties.

Manufacturing Chemists' Assn., Inc., issued on December 19th the pamphlet "Basic Memorandum: Pump Standardization Project." Memo covers tentative centrifugal pump standards promulgated by various interested groups listed therein under sponsorship of MCA and the Hydraulic Institute according to procedures of American Standards Assn.

Tentative standard comes before the full ASA Sectional Committee, B-73, for approval in February. Should approval be granted, final recommendations will be forwarded to the ASA for action. If processing by usual ASA procedures confirms that the recommendations are appropriate, ASA will then establish them officially as industry-wide standards for centrifugal pumps.—**Manufacturing Chemists Assn., Inc., 1625 Eye St., Washington, D. C. 86B**

BRIEFS

Plastic diaphragm valve, now available, operates at 300 F. and approaches glass in resistance to chemicals. Sized from ½ to 2 in., valve has excellent dimensional stability throughout operating temperature range.—**Hills-McCanna Co., 4568 West Touhy Ave., Chicago 30, Ill. 86C**

Three-way gun produces plastic laminates at 40% lower cost by delivering activated resin and chopped fiber-glass strands simultaneously, at rates up to 15 lb./min.—**Rand Development Corp., Cleveland, Ohio. 86D**

Self-priming, liquid-ring pump introduced recently by Goulds handles air, liquid or a combination of air and liquid. Available in cast iron or stainless steel with 1½-in. suction and discharge openings.—**Goulds Pumps, Inc., 30 Black Brook Rd., Seneca Falls, N. Y. 86E**

Fume washer constructed of glass-fiber-reinforced polyester resin weighs only ⅓ as much as steel washers, can handle corrosive vapors without damage. Motor and blower are housed separately. —**Line-O-Coat Co., 1230 South Santa Fe Ave., Compton, Calif. 86F**

Pipe insulation of woven ceramic-fiber tape bonded to pipe with zirconium-base cement is positive, shock-resistant combination that withstands temperatures to 2,000 F.—**Russell Mfg. Co., 572 East Main St., Middletown, Conn. 86G**

For More Information . . .

about any item in this department, circle its code number on the

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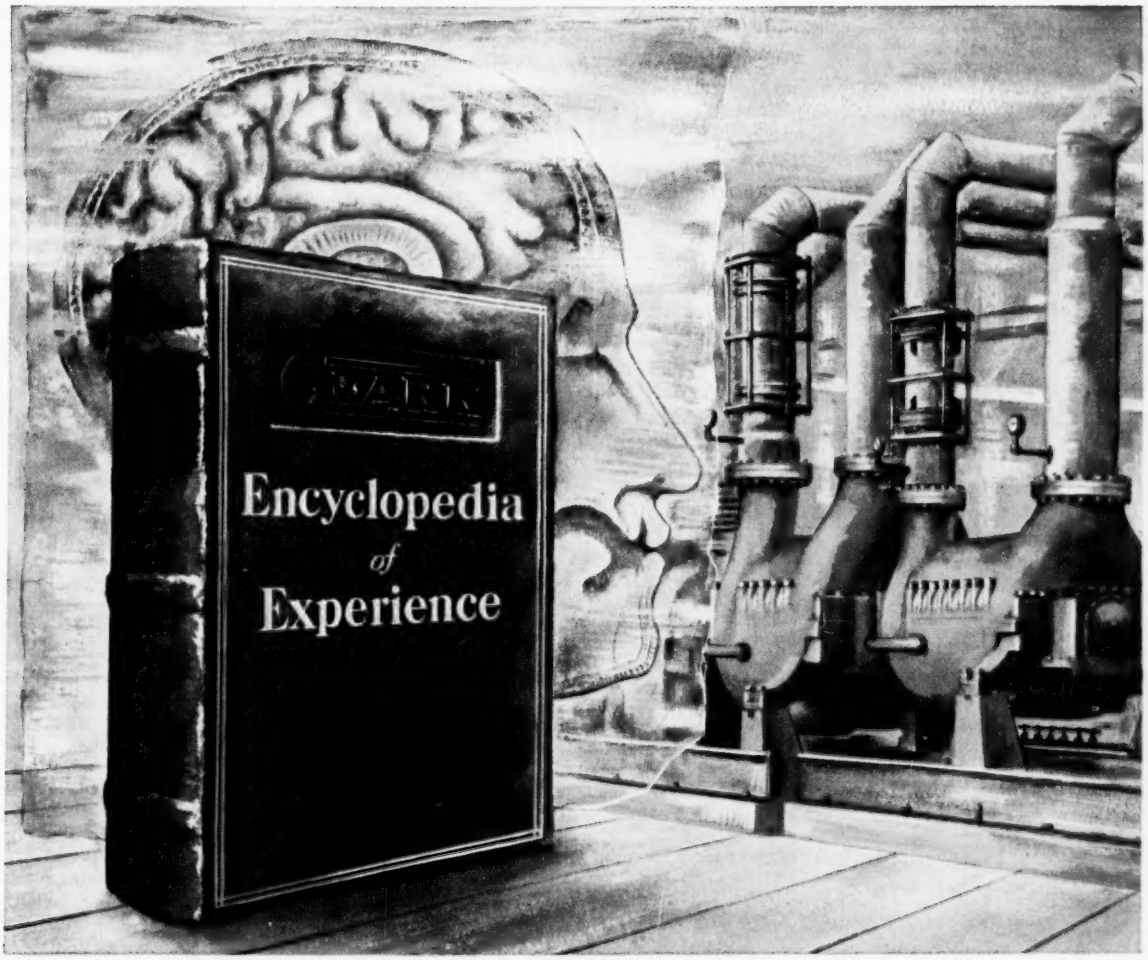

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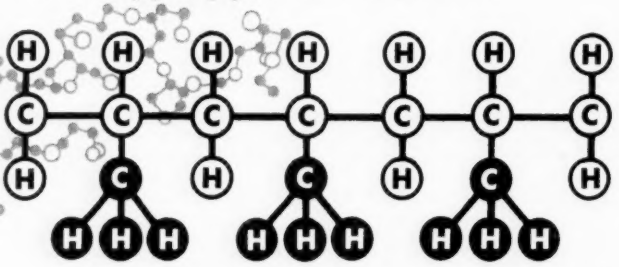
New Order in Polypropylene means . . .



. . . NEW ORDERS for PROPYLENE

Propylene Cracks the Polymer Market

The technology that produced the first solid, highly ordered polypropylene throws open enormous new chemical markets for propylene.

James W. Bradley, Robert L. James and Richard E. Messing,
Arthur D. Little, Inc., Cambridge, Mass.

Major new factor in propylene markets will without doubt be the synthesis of polypropylene. Until the recent brilliant work on "directed" polymerization of olefins by Natta, Ziegler, Phillips and others, all attempts to build propylene macromolecules had gotten only as far as the tetramer —an amorphous goo. Now precise orientation of monomers, under the influence of complex organometallic catalyst systems, yields a solid polymer.

Polypropylene's temperature resistance, toughness and processing properties will enable it to compete with both high-impact styrene resins and the new linear polyethylenes. And successful propylene polymerization points the way to new and unique resin combinations—e.g. propylene-ethylene copolymers.

* For authors' biographies, see *Chem. Eng.*, Dec. 1957, pp. 206-214.

▶ **Merchant Propylene Now** — Development of these new propylene markets should stimulate creation of merchant sources. For the polypropylene industry is expected to follow the pattern of the polyethylene field in which most of the entrants have chosen to rely on outside sources for basic hydrocarbons.

Although polypropylene has been getting headlines, manufacture of all chemicals from propane, butane and higher hydrocarbons is enjoying a rebirth.

Production of these materials is closely tied to refinery operations. Thus, use of intermediates such as propylene and butylene in making high-octane gasoline components has an important impact on availability of feedstocks for chemical upgrading.

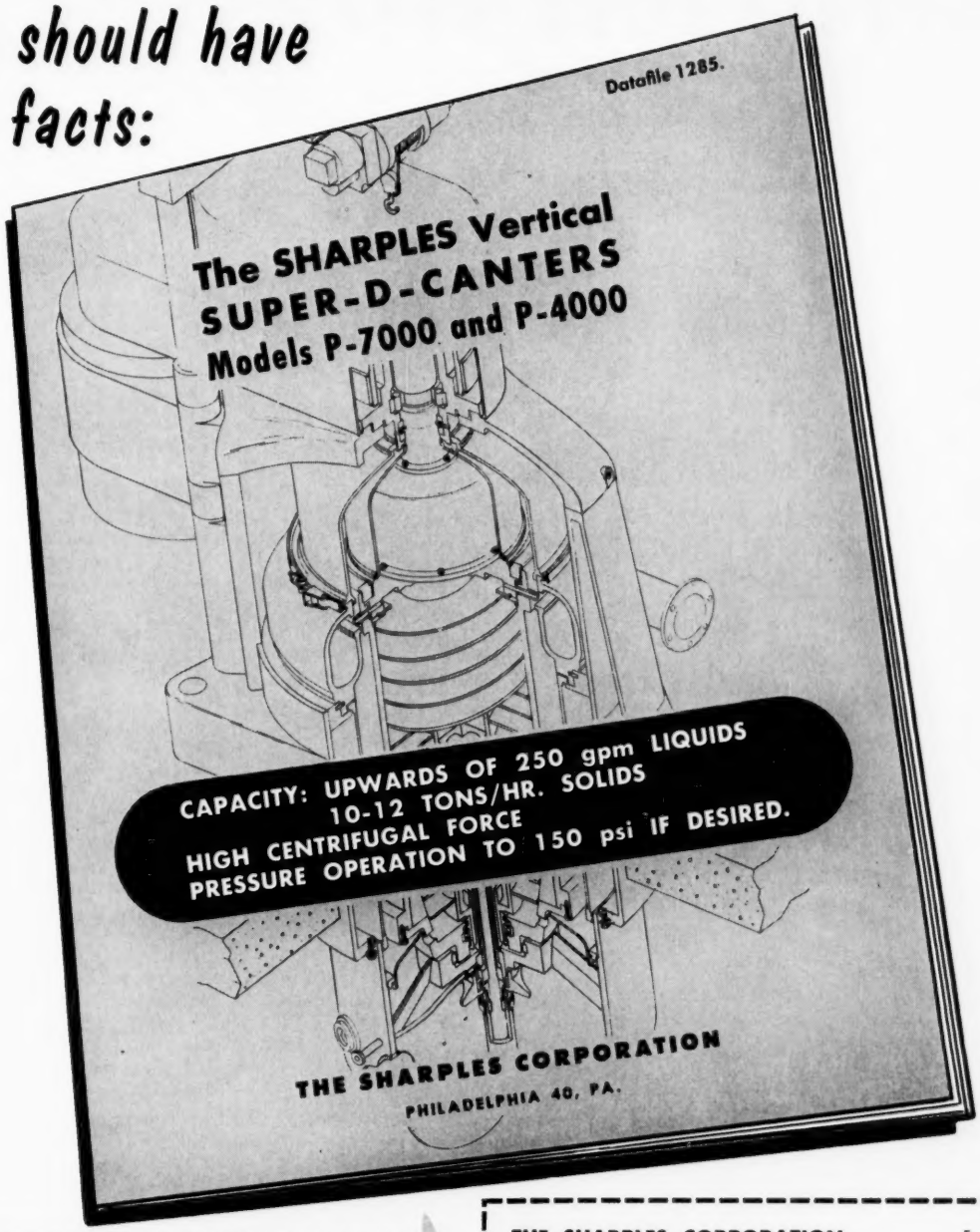
▶ **LPG Use Stablizes**—A second principal starting material for C_3 and C_4 chemicals is liquefied petroleum gas, also significantly influenced by the trend in fuel markets. Total LPG consumption in 1957 is estimated at about 6.9 billion gal. Domestic and motor fuels, the largest use, accounted for about 56% of total LPG. But chemical manufacture's share has risen to about 31%, and helps stabilize usage.

▶ **More Chemical Propylene** — Manufacture and utilization of propylene has probably received more attention during the past year than in any comparable period. Many arrangements have been discussed for providing propylene to plastic and chemical companies interested in upgrading it to derivatives like polypropylene and cumene. Much of the propylene now used in the chemical industry is a byproduct of catalytic cracking. Pro-

BUTYLENE . . . . . **p. 92**
Synthetic rubber still calls the shots.

IF YOU DEWATER SLURRIES...

You should have the facts:



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Chemical Propylene

Production (1957): 1.61 Billion Pounds (Est.)

Sources (1956)	%
Refinery gas, petroleum fractions	94
Other (LPG, fuel oil etc.)	6

End Uses (1956)	%
Isopropanol	53.8
Dodecene	25.6
Nonene	6.8
Propylene oxide	5.1
Allyl chloride	4.0
Cumene	3.6
Other	1.1

Isopropyl Alcohol

Production (1957): 1.10 Billion Pounds (Est.)

Sources (1956)	%
Propylene	100
Propane-butane oxidation	small

End Uses (1956)	%
Acetone	46.1
Solvents	16.7
Gasoline additives (deicing)	10.0
Other chemicals	13.3
Rubbing alcohol, cosmetics, drugs	8.4
Exports	5.5

Chemical Butylene

Production (1957): 1.74 Billion Pounds (Est.)

End Uses (1956)	%
N-Butylene (86% of butylene)	
Butadiene*	85.2
sec-Butanol	14.3
Amyl alcohol	0.5

* Butylene-derived only.

End Uses (1956)	%
Isobutylene (14% of butylene)	
Butyl rubber	72.4
Polyisobutylene	13.8
Tertiary butanol	9.1
Diisobutylene	4.3
Triisobutylene	0.4

Butadiene

Production (1957): 795,000 Tons (Est.)

Sources (1956)	%
Butylenes	62.8
Butane	23.9
Hydrocarbon cracking	11.1
Alcohol	2.2

End Uses (1956)	%
SBR polymer	90.3
Nitrile rubber	3.4
Styrene-butadiene latex	3.2
Nylon	1.9
High-styrene resins	0.5
Polystyrene modifications	0.5
Misc	0.2

pylene's principal market is in polymer gasoline, but increasing interest is being shown in its separation and sale as a petrochemical intermediate.

Although propylene prices vary considerably depending upon location, purity, and other factors, consensus seems to be they will compare favorably with those for ethylene, probably in the range of 4-5¢/lb.

The largest manufacturers of propylene are Union Carbide, Shell Chemical, Standard Oil of Calif., and Standard Oil of New Jersey (mostly for captive usage). Newer facilities, such as those of Atlantic Refining, Sinclair, and Texas Co., will contribute substantially to the supply for chemical upgrading.

► **Isopropanol Still First**—Isopropanol manufacture continues to lead consumption of chemical propylene, accounting for 54% in 1957. Future growth will probably be modest, since acetone (which accounts for about one-half of total isopropanol consumption) will be increasingly produced via other routes. The favorable price relationship to ethyl alcohol should, of course, continue to stimulate use of isopropanol as a solvent, gasoline additive, deicing material, and in other markets where the two materials compete.

Second most important outlet for chemical propylene is polymers of low weight, including nonene and dodecene. The latter, commonly known as propylene tetramer, serves as principal hydrocarbon base material for manufacture of alkyl aryl sulfonate detergents.

Propylene oxide has been utilized primarily for conversion to propylene glycol, but seems destined for additional major growth as a raw material for polyethers useful in polyurethane foams. Some chlorohydrin plants for ethylene oxide will probably be converted to propylene oxide manufacture since, for propylene, chlorohydrin is preferred over direct oxidation.

► **Acrolein, Allyl Alcohol**—Manufacture of acrolein and allyl alcohol represents one of the major growth areas for propylene. The new Shell process for manufacture of glycerin from allyl alcohol and hydrogen peroxide

ELI LILLY AND STANDARD OIL

thirty years as good neighbors in Indianapolis

J. [illegible], Director of Eli Lilly Purchasing Division, and R. J. Kaufman, Standard Oil [illegible] manager, stand before historic building on Lilly plant grounds. This [illegible] and its beginning in this building were then 61 years ago.

FOR MORE THAN 30 years Eli Lilly and Company and Standard Oil have been industrial neighbors in Indianapolis. Standard Oil supplies petroleum products to this leading pharmaceutical manufacturer's McCarty Street plant and its laboratory at Greenfield, Indiana, a short distance from Indianapolis.

In the course of these years as a supplier, Standard Oil technical service has accompanied the sale of petroleum products. This service has been supplied by men with experience in engineering and in the use of petroleum products. Standard's man currently on the Lilly account is John T. Stark, a native of Indianapolis. For five years, ever since graduating from Brown University with a degree in chemistry, John has been calling at Eli Lilly. He had 17 weeks off this assignment in 1953 to attend the Standard Oil Sales Engineering School, where he received special training in the application of petroleum products.

But underneath this relationship between supplier and customer—the technical service rendered, the courtesies given and received, products bought and products sold—there lies something even deeper, something that is very good. It is the respect two industrial companies have for one another, which has endured to mutual advantage for 30 years.

Perhaps your company has been a customer of Standard Oil's for many years. If not, we should like the opportunity to serve you as we have served Eli Lilly. We have 23 division offices in 15 Midwest and Rocky Mountain states. Call any of these offices. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD

STANDARD OIL COMPANY
(Indiana)

Butadiene

Producer	Location	Capacity (Tons)
From N-Butylene		
Copolymer Rubber & Chemical	Baton Rouge, La	30,000
Goodrich-Gulf Chemicals	Port Neches, Tex.	300,000
Texas U. S. Chemical	Port Neches, Tex.	
Humble Oil & Refining	Baytown, Tex	65,000
Petroleum Chemicals	Lake Charles, La	80,000
		475,000
From N-Butane		
Firestone Tire & Rubber	Orange, Tex	40,000
Odessa Butadiene	Odessa, Tex	50,000
Phillips Petroleum	Borger, Tex	112,000
Shell Chemical	El Segundo, Calif.	86,000
Standard Oil of Calif	El Segundo, Calif.	
Texas Butadiene & Chemical	Houston, Tex	86,000
		374,000
From N-Butylene-Butane		
Petro-Tex Chemical	Houston, Tex	200,000
		200,000
From Hydrocarbon Cracking		
Allied Chemical & Dye	Tonawanda, N. Y.	2,000
Dow Chemical	Midland, Mich. / Freeport, Tex.	17,400
Esso Standard Oil	Baton Rouge, La	50,000
Union Carbide	Seadrift, Tex. / Texas City, Tex. / S. Charleston, W. Va.	35,000
		104,400
From Alcohol		
Publicker Industries (Leased)	Louisville, Ky	87,000
		87,000
Total		1,240,400

should provide a considerable boost for acrolein and allyl alcohol, but will probably not represent any significant change in usage of propylene, the ultimate raw material. Manufacture of hydrogen peroxide via isopropanol oxidation, also yielding acetone as a coproduct, is another major shift in technology.

Synthesis of epichlorohydrin and synthetic glycerin via the chlorohydrin method should maintain growing markets for allyl chloride and, ultimately, for propylene. Growth in the market for epoxy resins will mean a substantially larger requirement for epichlorohydrin, although much of this capacity has already been planned.

▶ **Acetone Controls**—Cumene is the only other important market for propylene at present. Manufacture of cumene hydroperoxide, and its subsequent splitting to produce phenol and acetone, is now well established commercially, with three domestic producers and one Canadian.

Although much of the long-term phenol expansion will probably go via the cumene route, it's interesting to note that expansions via other methods, including sulfonation and chlorination of benzene, have continued. By-products from such operations are in some cases easier to dispose of than acetone produced from the cumene method.

AND NOW C_4 PETROCHEMICALS . . .

Butylene? Watch Rubber

Styrene-butadiene rubber keys *n*-butylene demand; isobutylene looks to butyl rubber.

The largest volume butane derivatives appear, at one time in their manufacture, as normal butylene. Or, to a lesser extent, as isobutylene, which is either isolated or remains *in situ* before conversion to other products. (One important exception is Celanese's direct oxidation of butane to produce oxygenated hydrocarbons.)

Dominant product made from *n*-butylene is butadiene, which accounts for 85% of total output. Secondary butyl alcohol, amyl alcohol and small miscellaneous uses make up the rest.

▶ **Butadiene Tied to Rubber**—Consumption of butadiene in 1957 was only about 3% greater than the 770,000 short tons used in 1956. This modest gain reflects lack of appreciable growth of butadiene's most important outlet—SBR (styrene-butadiene rubber) polymer. For the first nine months of last year SBR consumption (including exports) was up 71,000 long tons—11.5% over the same period in 1956. But SBR inventories were reduced by 45,000 tons at the same time.

SBR, which accounts for over 90% of total butadiene consumption, will continue to grow, but not so spectacularly as it has since the Korean War and immediately after private-industry purchase of the synthetic rubber industry.

Sixty-three per cent of all rubber used in the United States is now synthetic. While this share will continue to increase, most authorities agree that about one-third of our rubber must be natural rubber or its equivalent, polyisoprene; these polymers are required in such applications as

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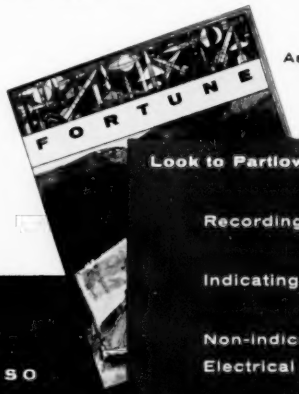

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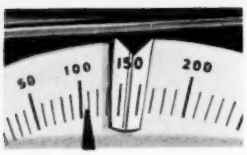

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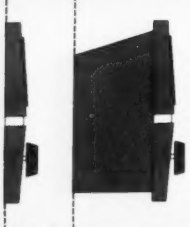

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PARTLOW

Pioneer in Mercury-Actuated Temperature Controls

truck tires, which need strength retention at higher temperatures.

▶**Too Much Butadiene?** — By 1958 overcapacity is likely to increase 40-45%—to 350,000 short tons—even after deleting the uneconomic alcohol-butadiene capacity. Competition, already keen, will become more intensive. There'll be pressure on butadiene's price of 14.5-15¢/lb., particularly among the merchant producers which account for 45% of capacity.

Most important trend in butadiene manufacture is emphasis on *n*-butane rather than *n*-butylene raw material. *N*-butylene requirements for alkylate to make high octane gasoline reduce its availability for butadiene. Most new butadiene capacity uses the Houdry process to convert *n*-butane to butadiene without isolating butylene.

Other smaller-volume derivatives of *n*-butylene—secondary butyl alcohol and amyl alcohol (via the OXO process)—continue to be almost entirely dependent on solvent applications. About 70% of the secondary butyl alcohol ends up as MEK, which is a solvent for lube-oil dewaxing and for lacquers. Modest growth—perhaps 4% per year—is visualized for both secondary butyl and amyl alcohols.

▶**As Butyl Rubber Goes . . .** — Total isobutylene consumption for all applications will grow modestly in the next ten years if butyl rubber is not used in tires, and much more if it is used for this purpose.

In 1956, about 72% of the 232 million lb. of chemical isobutylene was used for butyl rubber. Sharp declines in demand for butyl rubber after the tubeless tire was commercialized would perhaps have been even sharper if commercial and sales development had not emphasized new applications for the product.

However, Esso Standard and Armstrong Tire have conducted extensive tests on butyl tires. If price-performance of butyl is shown to be favorable compared with SBR, appreciable expansion in butyl demand will occur. In fact, the participation of butyl rubber in the tire market should be decided within the next two to three years.

INDUSTRY OUTPUT IN 1958:

To Level High Is Not to Slump

Despite some over-amplified hollering from some quarters, 1958 doesn't look at all like a bad year from here. It looks, in fact, like a pretty good one for industrial production—just a shade down from 1957. And we know how good last year was.

A recent roundup, by the McGraw-Hill Dept. of Economics, of 1958 prospects for 24 key industries shows that industrial output, while it may be leveling off this year, certainly won't be lagging much.

Summed up, the findings are: Physical output of 12 of the 24 industries will rise in 1958, output of four will hold steady, output of eight will dip. Weighted average: Down 1%.

Twenty-one of the 24 industries will show an output within 5% of 1957, 14 within 3%. Some of those industries which will slide the most—aircraft (−10%), machine-tools (−35%), railroad equipment (−33%)—usually tend to be more volatile anyway. For example, aircraft output rose 10% in 1957; railroad equipment, a whopping 25%; and machine tools held above 1956 (a peak year) until mid-1957.

Chemical production will rise 1-2% this year. And most of the big chemical-consuming industries—food, paper, paint, plastics, fertilizers, rubber, construction, textiles will do a little better (+2-5%) this year.

CHEMICALS—UP 1½%

Outlook for chemical-consuming industries 3-6% above average.

PETROLEUM REFINING—UP 2%

Less demand for home-heating and industrial fuels, but 2.5 million more cars are on the roads.

PAPER—SAME

Manufacturers stepping up operating rates. Inventories lower.

RUBBER—UP 5%

More and more cars and trucks on road. Replacement tires increase.

CONSTRUCTION MATERIALS—UP 5%

Stepped-up highway and public works programs. Housing starts up a bit. Ever-growing fix-it market.

TEXTILES—UP 2%

Reduced inventories. Upturn overdue.

STEEL—DOWN 4%

Demand off for machinery, railroad equipment, exports. Auto use same. Housing and appliances up.

NONFERROUS METALS—DOWN 3%

Lower-level industrial production hurts. Increase in housing and electronics helps.

AUTOS and TRUCKS—SAME

Easier credit. Car discounts possible.

RAILROAD EQUIPMENT—DOWN 33%

Railroaders plan to spend 27% less for capital equipment. Order-backlogs reduced 50%.

AIRCRAFT—DOWN 10%

Effects of defense cuts will prove too much for upturn expected late this year.

INSTRUMENTS AND CONTROLS—SAME

Trend to modernization just about balances 16% decline in nation's capital spending.

HEAVY ELECTRICAL EQUIPMENT—DOWN 5%

New orders running lower than year ago. Backlogs down.

MACHINE TOOLS—DOWN 35%

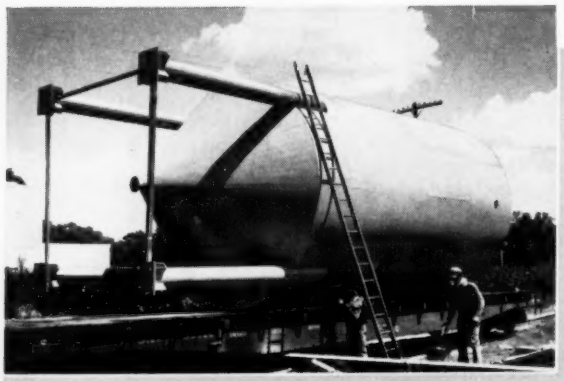
Backlogs shrink 50%. Capital spending cutbacks by industry.

In Custom Fabrication of

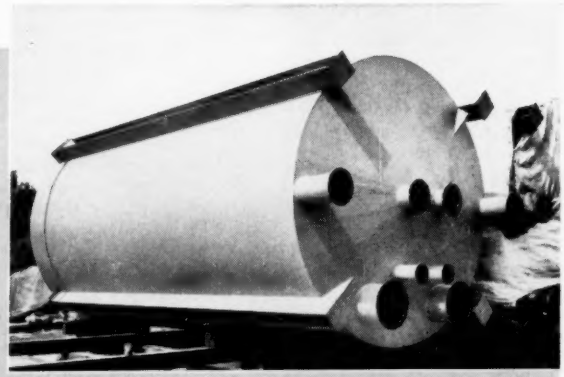
CODE TANKS and PRESSURE VESSELS

there is no substitute for *Experience*

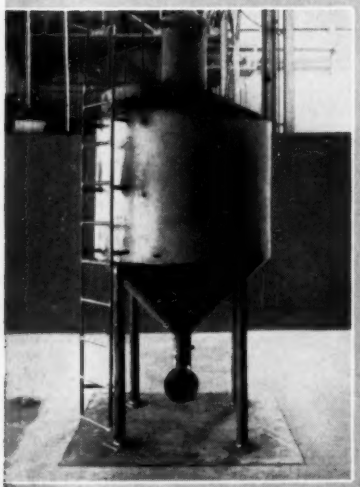
Modern Welding offers a wealth of experience in custom fabrication. Our well equipped strategically located plants serve chemical processing and petroleum industries throughout the world. Our facilities are at the disposal of the men who design, construct, operate and maintain processing plants.



Sludge Settler tank for petrochemical plant is the first in this revolutionary new design.



Dual purpose phenolic-lined polyethylene storage tank with structural reinforcements.



Calibration and prover tank for measuring the accuracy of pipeline crude oil meters.

Air receiver tanks for compressor stations. Pressure tested in 450 lbs. of hydrostatic pressure conforming to A.S.M.E. 1952-A code. Each X-ray tested.

MODERN TANKS QUALITY

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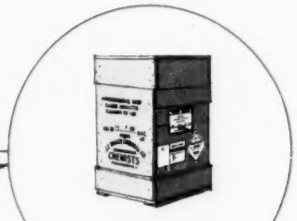
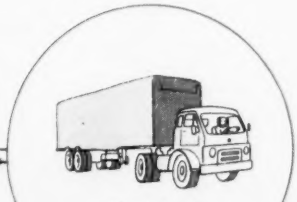
13 Gallon Carboy

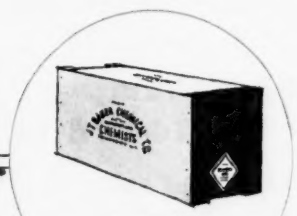


6½ Gallon Carboy



Truckload Of Carboys And Cases

Thro-A-Way Bottles And Case



Returnable Bottles And Case

Baker REAGENT ACIDS

Uniform high purity . . . any quantity . . . in the container of your choice

ALL J. T. BAKER REAGENT GRADE ACIDS—regardless of container or quantity—conform to stringent specifications. Every lot—regardless of end use—is subject to rigid controls established by J. T. Baker Chemical Co. to assure you of the highest standards of purity in the industry.

WHY J. T. BAKER REAGENT GRADE ACIDS FOR LARGE-SCALE PRODUCTION USE? Because they combine the advantages of controlled high purity and economy. Because they do an efficient, faster, more predictable job in industry upon industry. Investigate J. T. Baker acids to help you reduce testing time . . . eliminate one or more purification steps . . . minimize variables . . . cut costs without sacrifice of quality or control . . . upgrade your product.

HOW PURE ARE J. T. BAKER REAGENT GRADE ACIDS? Specifications for J. T. Baker Nitric, Sulfuric, Hydrochloric and Acetic Acids and for Ammonium Hydroxide appear below. See how they might work for you.

WHAT CONTAINER TYPES ARE AVAILABLE? 6½ and 13 gallon carboys; Thro-A-Way bottles and cases (6 five pint bottles per case); returnable bottles and cases (10 five pint bottles or 24 one pound bottles per case). Whatever quantity you need—pounds or tons—J. T. Baker offers you highest standards of purity—on-time shipment—economical price.

J. T. Baker Chemical Co.

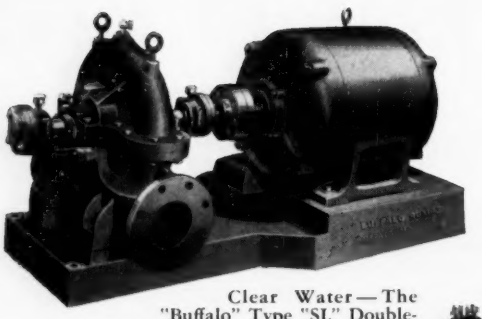
REAGENT · CHEMICAL · FINE · INDUSTRIAL

Phillipsburg, New Jersey

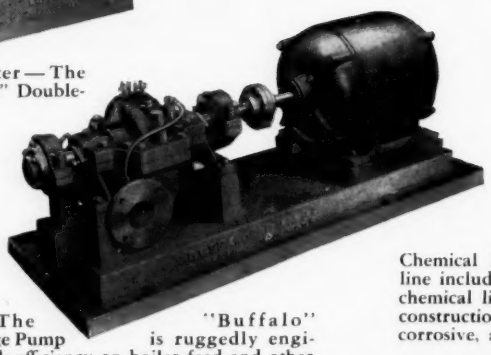
BAKER REAGENT SPECIFICATIONS

	Acetic Acid, Reagent, Glacial *($HC_2H_3O_2$) Meets A.C.S. Specifications	Hydrochloric Acid, Reagent *(HCl) Meets A.C.S. Specifications	Nitric Acid, Reagent *(HNO_3) Meets A.C.S. Specifications	Sulfuric Acid, Reagent *(H_2SO_4) Meets A.C.S. Specifications	Ammonium Hydroxide, Reagent *(NH_4OH) Meets A.C.S. Specifications
Assay (as *)	99.8%	36.5-38.0%	69.0-71.0%	95.0-98.0%	28.0-30.0%
Residue After Evaporation or Ignition	0.0010%	0.0004%	0.0004%	0.0004%	0.001%
Carbon Dioxide (CO_2)	–	–	–	–	0.002%
Chloride (Cl)	0.0001%	–	0.00005%	0.00001%	0.00005%
Phosphate (PO_4)	–	–	–	–	0.0001%
Sulfate (SO_4)	0.0001%	0.0001%	0.0001%	–	–
Sulfite (SO_3)	–	0.0001%	–	–	–
Total Sulfur (as SO_4)	–	–	–	–	0.0001%
Substances Reducing Permanganate	**PACST	–	–	0.0001%	**PACST
Nitrate	–	–	–	<0.00005%	–
Ammonium (NH_4)	–	0.0003%	–	0.0001%	–
Arsenic (As)	–	0.000001%	0.000001%	0.0000001%	–
Heavy Metals (as Pb)	0.00005%	0.0001%	0.00002%	0.0001%	0.00005%
Iron (Fe)	0.00002%	0.00001%	0.00002%	0.00002%	0.00001%
Copper (Cu)	0.00005%	0.00005%	0.00005%	0.00005%	–
Nickel (Ni)	0.00005%	0.00005%	0.00005%	0.00005%	–
Specific Gravity	–	1.185-1.192	1.416-1.424	1.84	0.902-0.896
Free Chlorine	–	0.0001%	–	–	–
Substances reducing $K_2Cr_2O_7$	PT	–	–	–	–

**Passes A.C.S. Test.

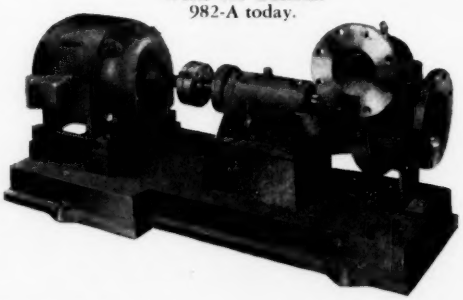


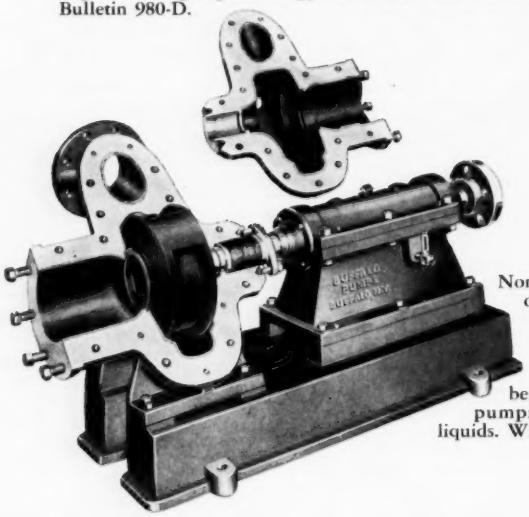
Clear Water — The "Buffalo" Type "SL" Double-Suction Pump is recognized for its highly efficient clear water service throughout industry. Capacities from 10 to 14,000 gpm. Write for Bulletin 955-R.



High Pressure — The "Buffalo" Type "RR" Multi-Stage Pump is ruggedly engineered to deliver peak efficiency on boiler feed and other clear water applications against heads as high as 1500 feet. Capacities range up to 900 gpm. For full details write for Bulletin 980-D.

Chemical Liquids — The complete "Buffalo" line includes ten specially designed pumps for chemical liquids. Available in several types of construction for handling a wide variety of corrosive, abrasive or high-consistency liquids. Write for Bulletin 982-A today.





Non-Clogging — "Buffalo" Diagonally Split-Shell Pumps are designed for moving high-consistency liquids, with down-time reduced to an absolute minimum. A number of models are available for pumping abrasive and corrosive liquids. Write for Bulletin 953-K.

WHATEVER YOUR LIQUID-MOVING PROBLEM, THERE'S PROBABLY A "BUFFALO" PUMP TO SOLVE IT!

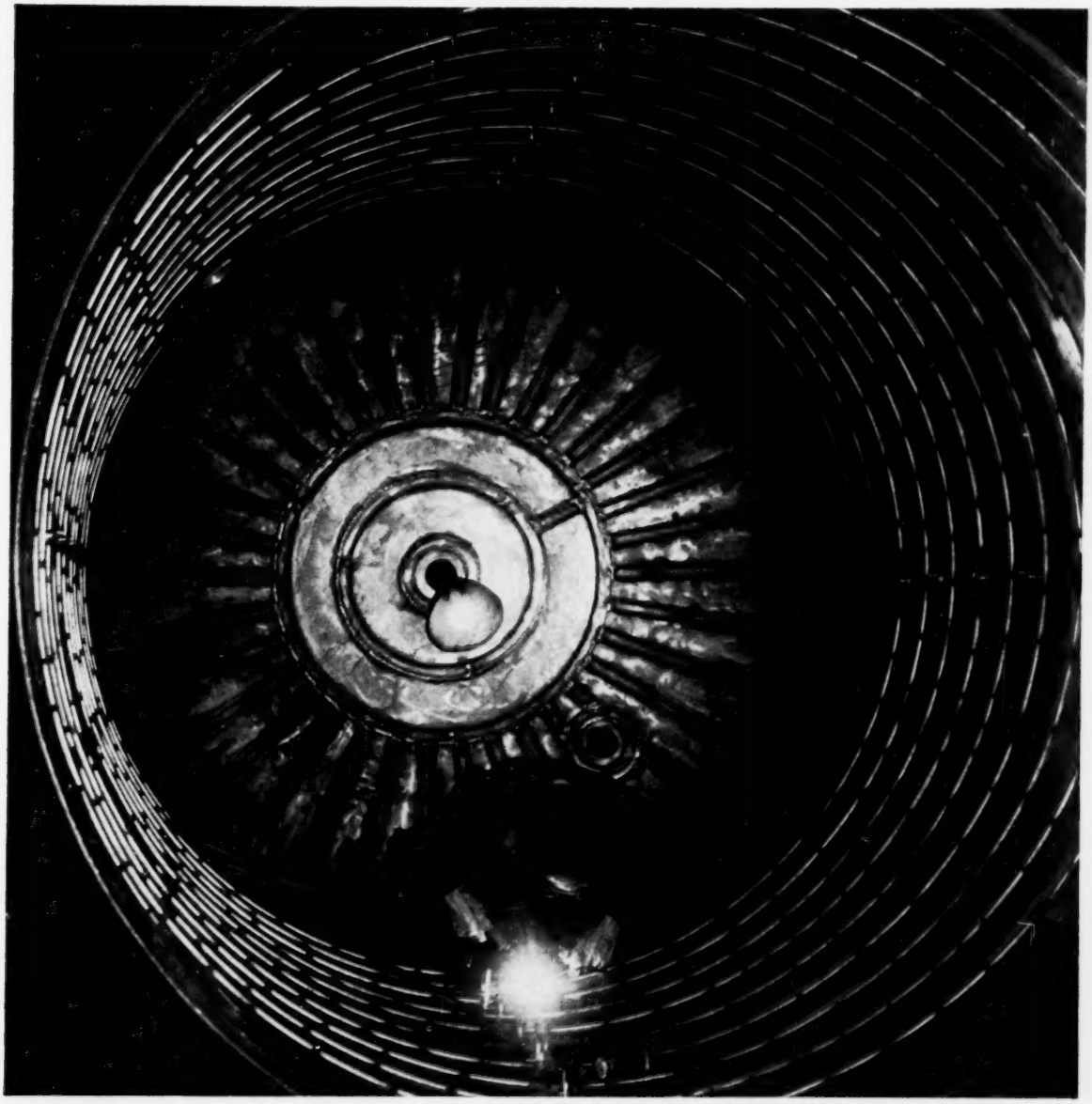
And the fact that "Buffalo" builds a *complete line* of pumps — a type, size and capacity to fit almost every liquid-moving need — can save you money right from the start. It means you never need to pay for "more pump" than you actually require.

You'll find a "Buffalo" Pump to match your exact requirements, with complete assurance of the utmost efficiency, dependability, ease of maintenance and long-range economy. Just contact your nearest "Buffalo" engineering representative, or write us direct. We'll be glad to recommend the pump that's best-suited to your needs.

THE COMPLETE "BUFFALO" LINE ALSO INCLUDES: Heat Transfer Pumps, Close-Coupled Pumps, Sump Pumps and Raw Sewage Pumps. Special alloys available in all models.

Engineered into every "Buffalo" Pump is the famous "Q" Factor — the built-in QUALITY which provides trouble-free satisfaction and long life.

BUFFALO PUMPS
DIVISION OF BUFFALO FORGE CO.
501 Broadway • Buffalo, N. Y.
Canada Pumps Ltd., Kitchener, Ont.
Sales Representatives in All Principal Cities
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



A Reactor That Won't React — To Corrosion!

Designed for 300 psig at 450F, this reactor will be subjected to unusually corrosive service. Hastelloy, a non-ferrous nickel-base alloy, was specified to line the vessel. The ASME Code shell was first lined with narrow strips and segments by manual metallic-arc welding. Then the welds were covered by cap strips, heliarc-welded to the liner. Multiple tests confirmed the excellence of the welds. Manually welding so many feet of alloy called for the most skilled craftsmanship—the type of craftsmanship Graver has characteristically applied to alloy fabrication for years. When custom-crafted vessels in special alloys are the answer to your corrosion problem, calling in Graver assures quality fabrication, long life and dependable service.

GRAVER®
ALLOY DIVISION

Building for the Future on a Century of Craftsmanship in Steels and Alloys

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New York • Philadelphia • Edge Moor, Delaware • Pittsburgh
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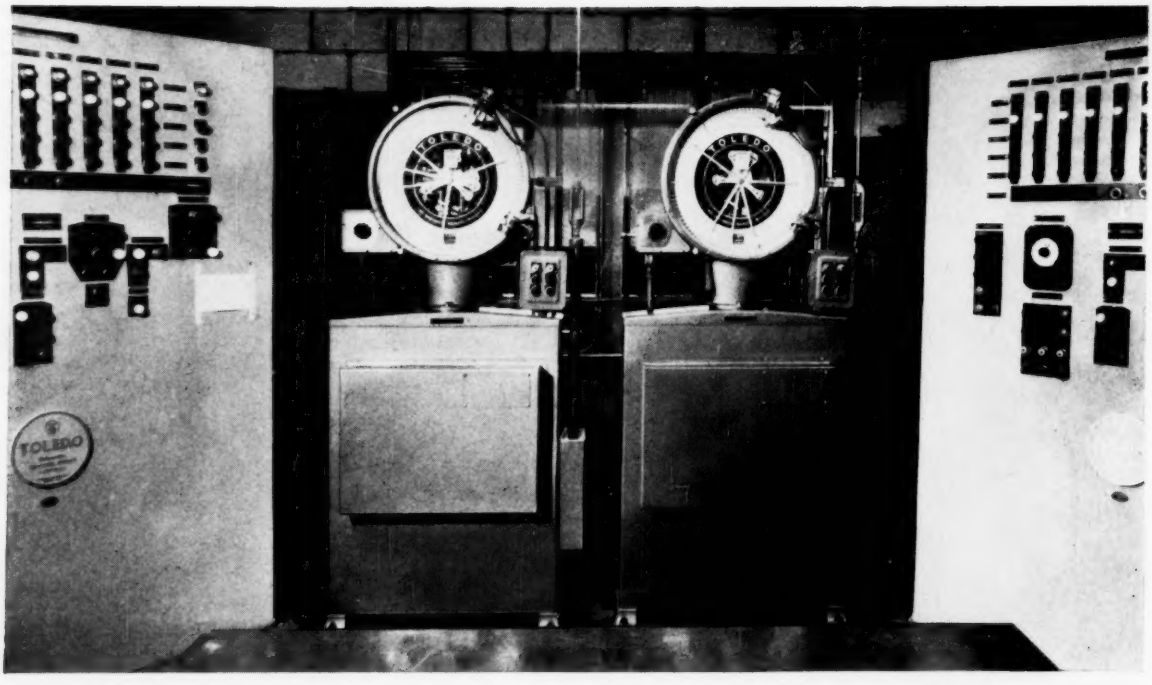
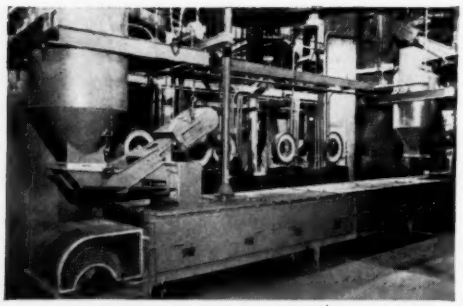


TOLEDOS control glass batching systems at Ford Motor Company's Nashville Plant



Two scale hoppers load conveyor with ingredients for plate glass. In background, a conveyor for sheet glass batch.

These Toledos are extra sensitive to weigh small quantities of ingredients such as carbon and iron oxide.

Automatic batching—using a Toledo system of weight control—helps the Ford Motor Company keep a watchful eye on quality and costs in production of glass at their Nashville plant.

All scales, hopper gates and feeder controls are interlocked and sequenced through the Toledo control panels shown in the photo above. Signal lights on the panels show progress of each batch cycle. The scale heads in the center provide a weight check for each complete batch before mixing.

On the floor above the control room, batch ingredients—soda ash, sand, carbon and iron oxide, for instance, are weighed and discharged onto conveyors by Toledo Hopper Scales. After mixing, another Toledo weighs out a preset amount of batch for the furnace. It's a continuous process calling for continuous control with speed and accuracy.

Let us help you find an efficient, cost-saving way to solve weighing problems in your plant. Write . . . TOLEDO SCALE Division of Toledo Scale Corp., Toledo 13, Ohio.

TOLEDO®

HEADQUARTERS FOR WEIGHING SYSTEMS

SERVICE Factory-Trained 200 Cities

FLOOR AND TRUCK SCALES

BENCH AND PORTABLE SCALES

OVER-UNDER SCALES

WEIGHT PRINTING

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COUNTING SCALES

BRIEFS for buyers of

Phosphorus Chlorides
Sodium Sulfides
Carbonate of Potash
Oxalic Acid

Phosphorus chlorides . . . growing, growing

You will be hearing more about the Hooker phosphorus chlorides described below. Current trends in organic synthesis are creating a growing need for the properties they put at your command.

Phosphorus oxychloride, $POCl_3$, is something you'll want to investigate if you're developing organic phosphates or plasticizers, gasoline additives, fire-resistant hydraulic fluids, or chlorinated products.

As a chlorinating agent, it neatly supplements and broadens your already wide choice of Hooker chlorine compounds. It's used also as a catalyst for intermediates and dyestuffs, and in preparation of medicinals such as sulfa drugs.

A clear water-white liquid, it assays 99.5% min. $POCl_3$; contains no free chlorine or phosphorus pentachloride.

Phosphorus trichloride, PCl_3, is fast winning repute as a convenient entry to many types of organic synthesis. You can use it as a chlorinating agent in manufacture of organic acid chlorides; as a condensing agent in preparation of organic aldehydes; in making phosphite and phosphonate esters; and as a catalyst in certain chlorination reactions. It's a clear water-white liquid of 99.5% minimum purity.

If you're already buying either of these versatile products in quantity, or plan to do so soon, be sure your supplier has what it takes to get the material to you promptly. Both these chemicals require special handling; volume deliveries are usually made in lead-lined, insulated tank cars.

When you purchase from Hooker, you *can* be sure, because you have at your disposal the largest fleet in the country of these special cars.

For contract information, write us. For technical data sheets, just check the coupon.

Sulfide economics

A different molecule might save you money. If you're buying sodium sulfide as a source of combined sulfur, here's a way to get the sulfur for more than 5 cent a pound less.

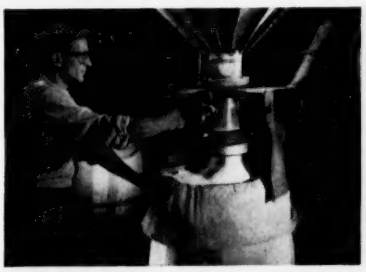
Just switch to Hooker *sodium sulfhydrate*.

In 100 lbs. of sodium sulfide, you get about 24.6 lbs. of combined sulfur. The same weight of sodium sulfhydrate gives you about 40 lbs. of sulfur—about 62.6% more.

At prevailing prices, the sulfur in sodium sulfide costs you about $ .244 a pound. In sodium sulfhydrate, it's only about $ .181 a pound.

Your actual saving is larger than the difference—because sodium sulfhydrate contains less water of crystallization, so freight cost is lower.

If this approach to lower-cost sulfidity looks like a good one for you, why not explore it with your Hooker salesman? He'll gladly help you review the facts with your specific needs in mind.



K_2CO_3: so pure you can see through it

Chances are good that some of this free-flowing white material occupies a prominent place in your living room.

One of many interesting uses of NIALK® carbonate of potash is in making clear glass. Your 21-inch TV picture tube contains about five and a half pounds of carbonate. It also goes into glass you read through, fluorescent lights you read by, glass you drink from, glass *objets d'art* you look at in museums.

Carbonate of potash has many other uses, but the important point about *this* use is that the carbonate must be of high purity. Ours is.

One essential step that helps preserve this purity is the packaging operation you see here. Carbonate of potash in solid form is highly hygroscopic, so we protect it with a moisure-resistant lining in every barrel, fiber drum, or bag of it we send you. If you use large amounts, we ship it to you in specially designed 50-ton dry-chemical hopper cars.

You can get NIALK K_2CO_3 as a liquid at 47-52% strength, though most users prefer to save freight by having it shipped in one of these four solid forms:

1. *Hydrate, regular,* 83.5-84%. This dust-free form is made from liquid K_2CO_3 which we evaporate to crystallize the solid sesquihydrate.

2. *Calcined, regular,* 99+%. The hydrate form is calcined to take water content down to less than 1%. It's granular, dust-free.

3. *Calcined powder,* 99+%. If your process won't accommodate the granular form, you can have this powdered form in your choice of three particle sizes.

4. *Powder,* 91-94%.

High purity . . . dust-free granular forms . . . wide choice of containers . . . moisture-resistant packaging for dry forms—these are some of the reasons why industry buys more NIALK carbonate of potash than any other brand.

May we show you how these advantages can help *your* process move more smoothly?

New data on oxalic acid

To keep your technical file up to date, send for our newest publication on OLDBURY® oxalic acid: Data Sheet No. 789.

It lists specifications, typical physical properties, packing data, uses, and handling precautions. For a copy, check the coupon.

For more information on chemicals mentioned on this page, check here:

- ☐ Phosphorus Oxychloride
- ☐ Phosphorus Trichloride
- ☐ Phosphorus Pentachloride
- ☐ Sodium Sulfhydrate
- ☐ Sodium Sulfide
- ☐ Carbonate of Potash
- ☐ Oxalic Acid
- ☐ New list of products—Bulletin 100-A

Clip and mail to us with your name, title, company address. (*When requesting samples, please use business letterhead.*)

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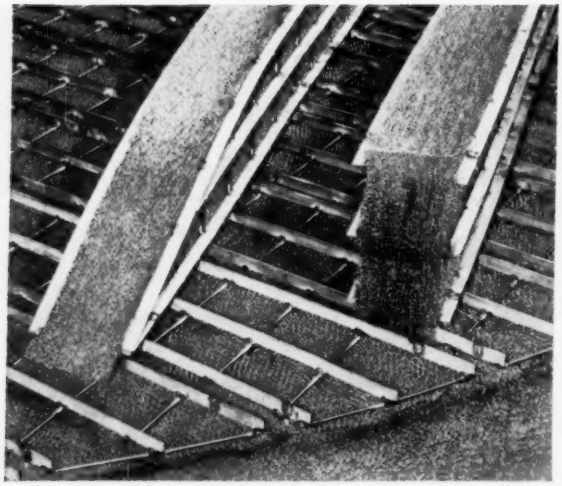
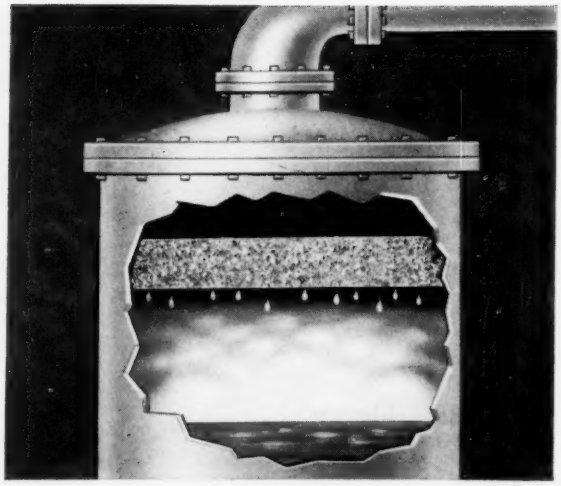
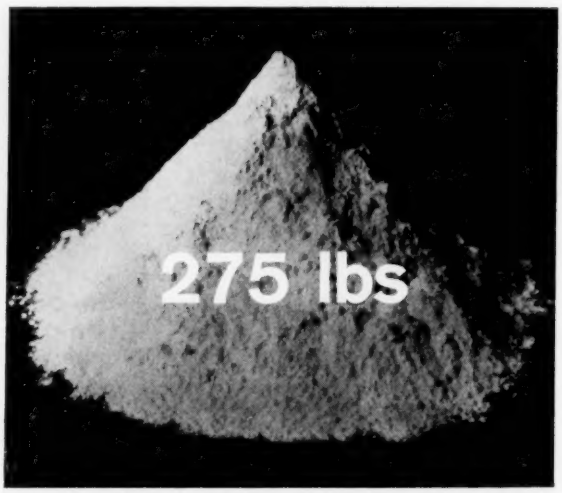
HOOKER CHEMICALS PLASTICS





Nickel wire mist eliminator... in 8½-foot evaporator...



Stops corrosion of 30-inch vapor line... and saves $8 worth of NaOH per day

Costly carryover of corrosive liquids entrained in vapor can be stopped easily and economically with Nickel Alloy wire mist eliminators.

That was proved again very recently by the experience of Frontier Chemical Company, a Division of Union Chemical and Materials Corp.

Frontier concentrates some 50 tons per day of 50% NaOH in an 8½-foot evaporator. Caustic carryover from the evaporator was causing an $8 per day loss in product and expense of neutralization. The 30-inch vapor line was corroding badly, too, and expensive replacement was just around the corner.

Separators ruled out on costs

Frontier's engineers looked into several separator devices but the knitted Nickel wire mist eliminator shown above cost less than half as much. It requires no major change in the vessel and can be installed through the manhole. The pad provides about 100 square feet of droplet collection area per cubic foot but reduces free volume by less than 3%. The Nickel insures against corrosion and contamination problems.

Four trouble-free years

Frontier reports that the only maintenance required in four years has been a twice-weekly 30-minute backwash with water to remove solid particles.

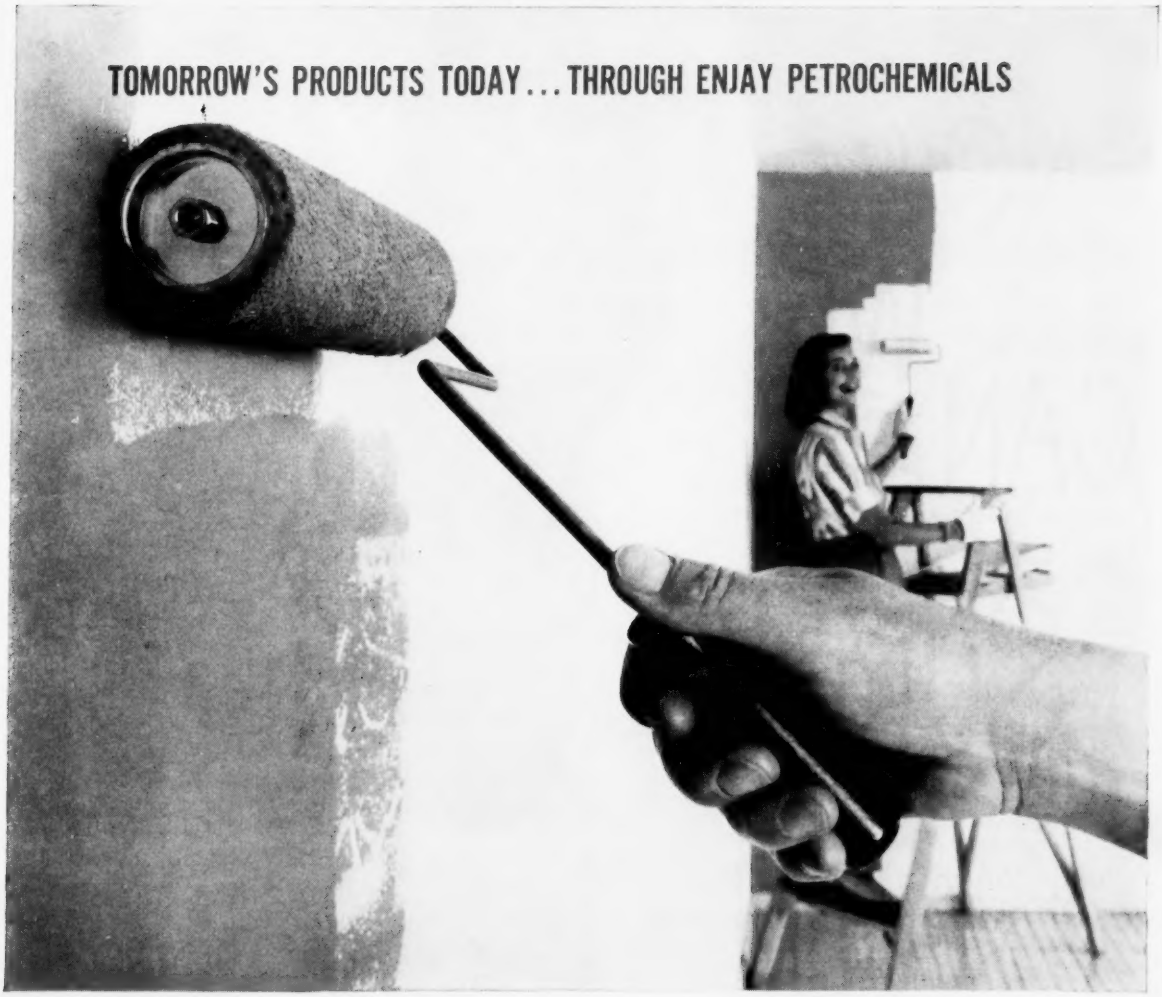
Are you having trouble from carryover of corrosive chemicals? Write for a list of mist eliminator manufacturers.

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

INCO

INCO NICKEL ALLOYS

TOMORROW'S PRODUCTS TODAY... THROUGH ENJAY PETROCHEMICALS



Basic ingredients for LATEX PAINTS that add that professional touch!

With the modern trend of "do-it-yourself," easy-to-apply latex paints are a growing favorite with today's home-owners. Increased competition for a share of this rapidly expanding market makes it essential for manufacturers to obtain top-quality raw materials for their products.

Enjay Butadiene, like all Enjay petrochemicals, meets rigid specifications for purity and uniformity and is excellent for the manufacture of high-quality latex paints.

For technical assistance in the application of Enjay Butadiene or any other of the many Enjay petrochemicals to *your* product, the recently expanded Enjay Laboratories offer the industry's most modern testing and research facilities. Write or phone for complete information.

Enjay offers a widely diversified line of Petrochemicals for industry:

ALCOHOLS & SOLVENTS: Lower Alcohols, Oxo Alcohols, Ketones and Solvents; OIL & FUEL IMPROVERS: Detergent-Inhibitors, V-I Improvers, Oxidation-Inhibitors; CHEMICAL RAW MATERIALS: Olefins, Diolefins, Aromatics; ENJAY BUTYL RUBBER & VISTANEX.

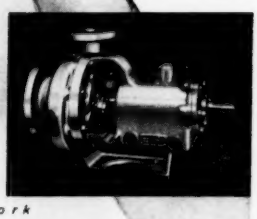
ENJAY

Pioneer in Petrochemicals

ENJAY COMPANY, INC., 15 W. 51st STREET, NEW YORK 19, N. Y. Akron, Boston, Chicago, Detroit, Los Angeles, New Orleans, Tulsa

"NOW-WE CAN BE SURE!"

Pump Buyers are saying this about Peerless Process Pumps—



PEERLESS PUMPS

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

Putting Ideas to Work

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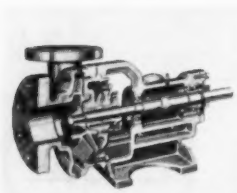
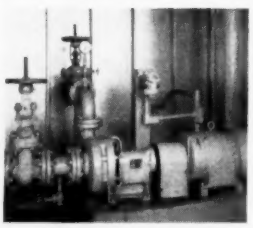
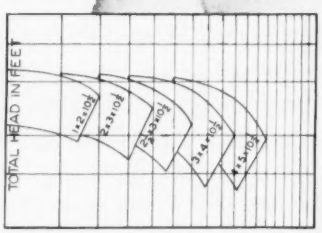


THEY OFFER the type of quality construction that measures up to any standard. Continual checking at every stage of manufacture guarantees the buyer performance he can count on in the field. *The best!*



THEY PROVIDE the performance you expect and pay for, backed by actual operating records of Peerless pumps in installations like yours. Durability, dependability, efficiency—*all proved in service.*



THEY MEET *exactly* every pumping requirement, handle any job in your system that calls for a pump. The *complete* Peerless range offers *all* types of chemical process pumps, in *all* sizes and frames.

AN EXAMPLE of Peerless research is this recently released bulletin on the effects of radial loads in process pumps, "MECHANICAL CONSIDERATION IN PUMP DESIGN." Request Bulletin No. EM-79.

new

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They are ideal for chemical processing, refining, food processing, sewage treatment and papermaking. Use the convenient coupon to get your free copy of our new booklet containing detailed information on new grating type Alcoa Aluminum Stair Treads. Or if more convenient, call the Alcoa sales office listed in the Yellow Pages of your telephone directory.

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SIZES AVAILABLE:
Lengths: 24", 30", 36", 42".
Standard width: 10". Special widths: $8^{27}/_{32}$", $7^{11}/_{16}$", $6^{11}/_{32}$".

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"Bimetal Freeze-up" Can Be More Serious Than Dial Fogging Problem

The first sign of moisture in a dial thermometer usually shows up as condensation inside the dial glass. You are probably familiar with this dial fogging problem which causes difficult reading and the eventual corrosion of the bimetallic element. You may not, however, be familiar with another and actually more serious moisture problem —bimetal "freeze-up."

Both dial fogging and bimetal freeze-up are permanently prevented by RMC's dry air hermetic sealing process.

If moisture is sealed in, or enters a thermometer dial it will find its way to the bimetal element. Then at extreme low temperatures this moisture freezes on the element and bearing surfaces, and the bimetal element will not function should the temperature go lower. Therefore, the operator of the equipment would never know that the temperature had gone below the last indication when the element became frozen.

Here's what makes such a condition hard to spot. The thermometer would operate properly again after a temperature rise of perhaps 20°, and would continue accurate indication even though the fluid dropped again to an even lower temperature than before. However, after it remained at the new low for a few hours, it would again freeze up. Then, as before, any further drop in temperature would not be indicated.

Only a dry-air hermetic seal, as used by RMC, can prevent both dial fogging and bimetal freeze-up. RMC even goes a step further by providing for recalibration at any time without breaking the air-tight seal. An external dial reset screw—exclusive with RMC—permits recalibration without opening the instrument in any way.

Industrial Needs Call For Magnetic Liquid Level Gauge

Magnetic drive provides accurate readings with complete safety in all types of liquids under pressure. RMC Magnetic Level Gauges meet requirements of the Underwriters' Laboratories and A.S.M.E. Boiler Code.

Write, wire or phone—tell us your requirements for indicating instruments, and let RMC engineering skill provide the answers. Rochester Mfg. Co., 113 Rockwood St., Rochester 10, N. Y.

These RMC thermometers have just been submerged in water for 15 minutes—the first of a series of severe tests given RMC thermometers to make sure hermetic seal is perfect.

We make certain that moisture will never bother your RMC thermometer

The RMC hermetic sealing process makes absolutely certain that humid air will not be sealed in the instrument and locks all moisture out permanently. Each thermometer then goes through a series of severe tests. Only those with perfect sealing are accepted for delivery. When you order from RMC you get the *only* industrial thermometer that can *never* be affected by internal dial fogging or bimetal freeze-up.

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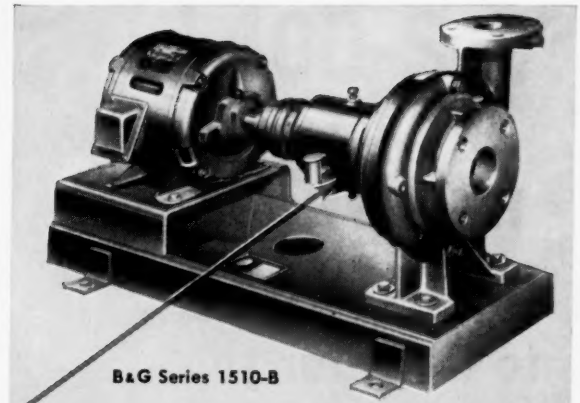
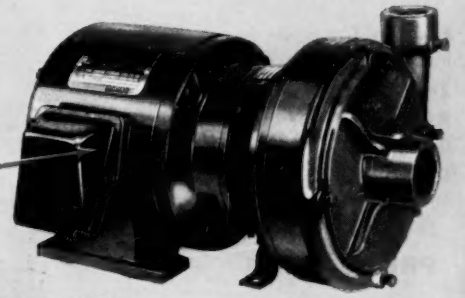


B&G Series 1510-B



B&G Series 1531-B

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B&G maintains a factory stock of the most commonly used sizes of centrifugal pumps for immediate delivery. Base mounted and integral-motor pumps as listed in B&G Stock Pump Catalog are available in capacities to 325 GPM, heads to 140 ft.

Why B&G Centrifugal Pumps give years of trouble-free service is evident from their design features. Vertical split case construction permits removal of the bearing bracket without disconnecting pipe lines or motor leads. Special alloy steel shafts are super-finished and over-sized to keep deflection at a minimum.

Leak-proof operation is assured by the "Remite" Mechanical Seal—an exclusive B&G development. "Remite" is so hard it will cut glass—eliminates packing rings and gland adjustment. Seal is self-lubricating.

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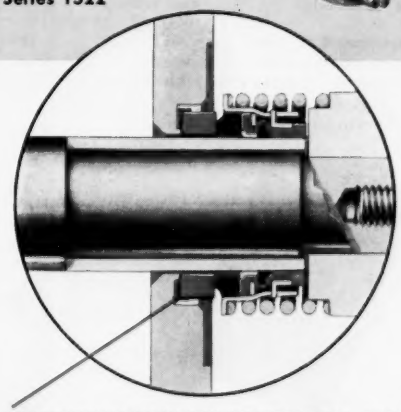

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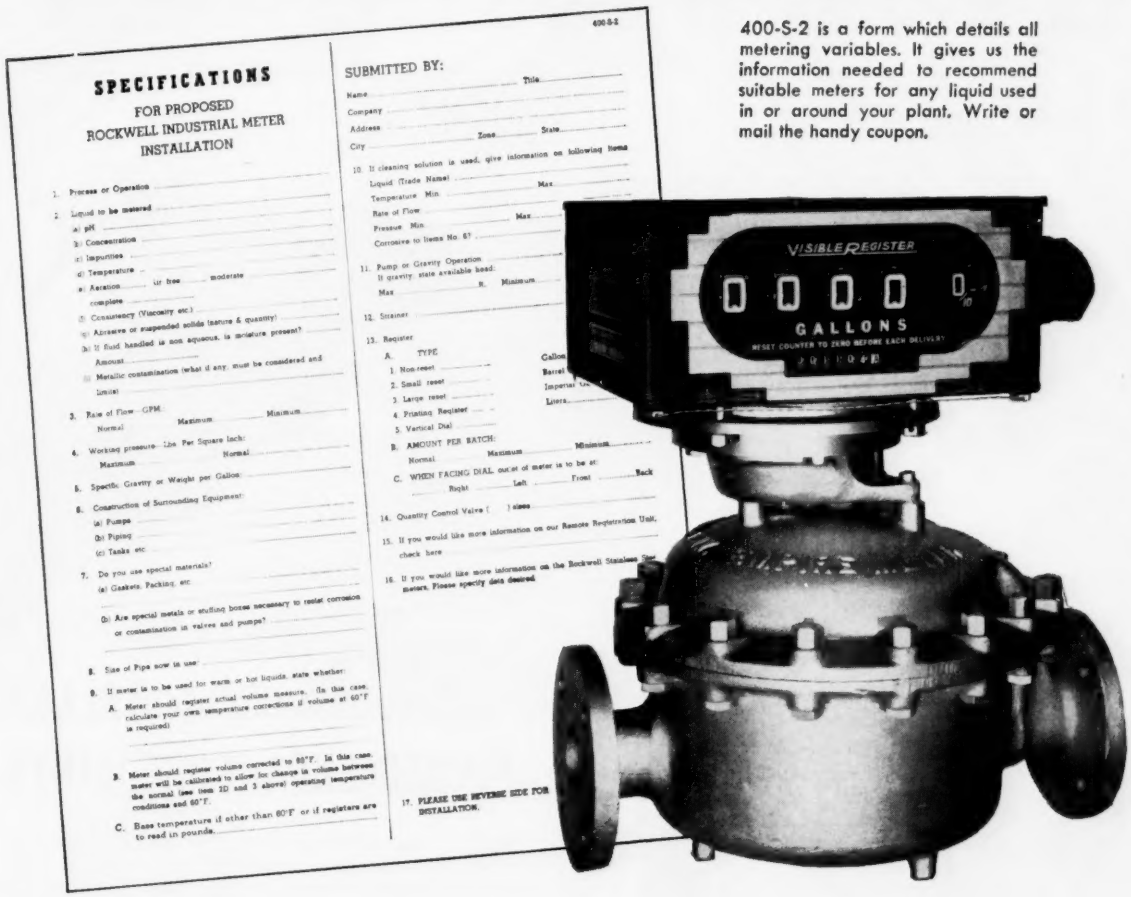

400-S-2 is a form which details all metering variables. It gives us the information needed to recommend suitable meters for any liquid used in or around your plant. Write or mail the handy coupon.

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For piping systems that can't be anchored, use ZALLEA HINGED EXPANSION JOINTS

Piping systems like the one in this 63,750 bbl/day catalytic cracking unit, one of the world's largest, at Gulf Oil Corp. Girard Point Refinery, have to be entirely self supporting. The entire cracking unit . . . reactor, regenerator and all connecting lines . . . is suspended in a huge structural steel framework, counterweighted to keep the system in balance, and fitted with Zallea Hinged Expansion Joints to provide vital flexibility plus support for the reactor.

In the 150 ft. air supply line, all thermal movement of the piping is absorbed by angular displacement in three 42″ dia. Zallea Hinged Expansion Joints. Start-up air in this line is at 1000°F. Under operating conditions it is delivered at 250°F, 25 psig.

Two 50″ dia. Zallea Hinged Expansion Joints in the spent catalyst line carry fluidized cracking catalyst at 950°F, 13 psig.

Since this cracking unit first went on stream, these Zallea Expansion Joints have given completely trouble-free service.

Process piping of any kind can be fully protected with one or more Zallea Expansion Joints. From the complete Zallea line you can select the expansion joint or combination of expansion joints best suited to your particular problems.

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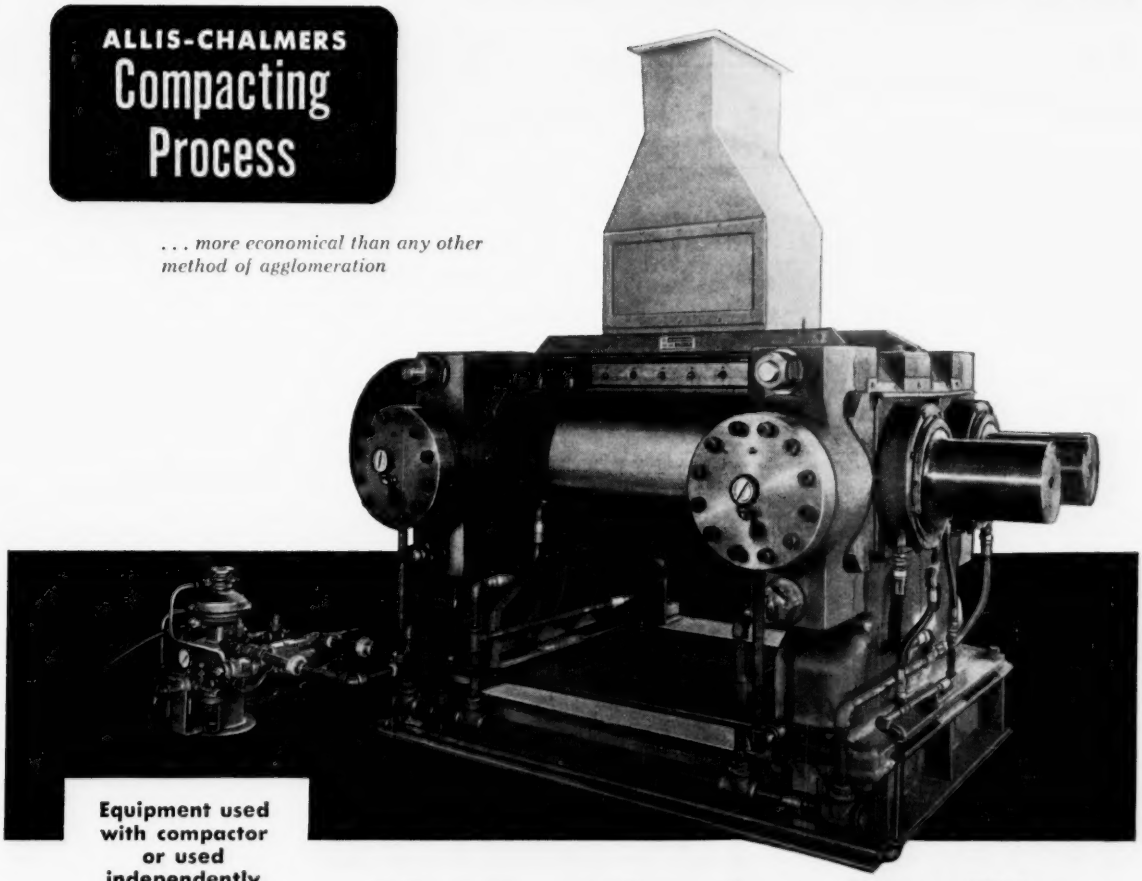
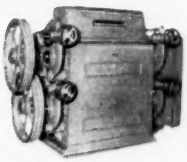
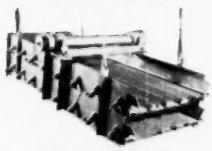


Equipment used with compactor or used independently



Granulating Mill

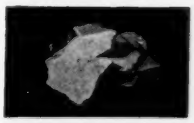


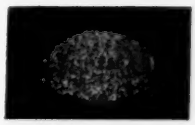
Aero-Vibe Screen

Gyratory Screen

Upgrade for Profits ...Mechanically

Precise control of *particle size, density* and *solubility factors* is now assured with the Allis-Chalmers compacting process. The heart of this efficient, completely mechanical system is this new Allis-Chalmers compacting mill.





Converts Loss into Profit

By-product material, too fine for use, from the original process, is first densified into slabs or flakes in the compacting mill. Agglomerated product is then granulated in the roller-type mill and separated in the vibrating or gyratory screen. This conversion of by-product material into a usable product changes loss into added profits.

Get Bulletin 07B8836 for the complete story. Ask your A-C representative for a copy, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

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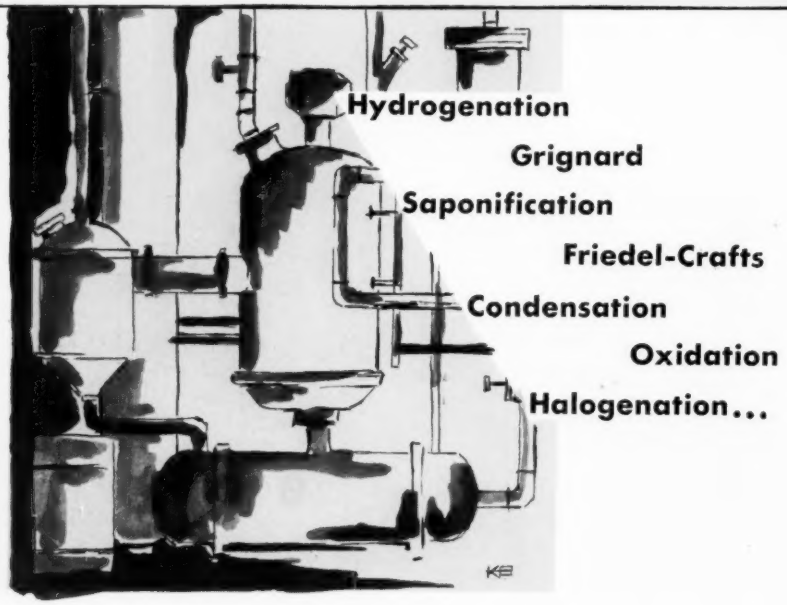


Process-Studded Plant: Key to Fragrances

"A FINE perfume is much like a piece of music," oberves one top perfumer at Van Ameringen-Haebler. "To achieve a distinctive aesthetic composition, we harmonize individual notes."

The notes, in this case, are the exceptionally high-purity aromatic chemicals produced by Van Ameringen-Haebler Inc. at its Union Beach, N. J., facility. Currently in the process of a $1.5-million expansion, the installation now turns out over 2.5 million lb./yr. of some 1,000 different perfume materials to be blended into fragrances for cosmetics, soaps, detergents and perfumes.

What does it take to provide this full register of "notes"? No longer a matter of stomping barefoot in a bucket of rose petals, modern fragrance manufacture relies on practically every unit process and unit operation in the book. In fact, a tour through the process-studded Union Beach plant might very well serve as an introductory course in chemical engineering.

For there, VAH runs Friedel-Crafts and Grignard reactions, condensations and hydrogenations, halogenations and oxidations among many others. And it operates distillation towers, filters, reactors, evaporators and so on.

▶ **Scheduling for Variety**—One chief consideration in operating this varied installation, R. W. Teegarden, Ass't. to Vice Pres. of Manufacturing, points out, is the efficient use of equipment.

As might be expected, in light of the great number of fragrances produced, many items are specialties turned out only on an intermittent basis. To prevent capital investment in these products from standing idle, VAH uses its equipment to handle more than one job. For example, a condensation reaction will occupy a reactor for a few days, then give way to an oxidation or halogenation. And a battery of distillation columns serves to purify practically every fragrance made.

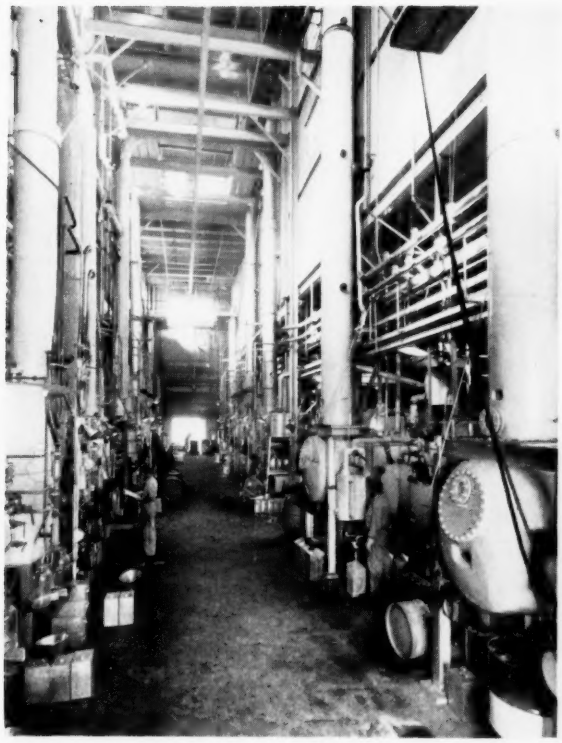
Thus, to avoid production bottlenecks on the one hand and idle equipment on the other, VAH must practice clockwork scheduling.

▶ **Olefactory Purity, Too**—Another key concern of VAH engineers is quality control. To be worthy of a place in fine fragrances, the aromatic materials must be of exceptionally high chemical purity. To this end, instrumentation is extensive throughout the plant, controlling operating conditions closely. And VAH operates an elaborate test lab, equipped for infrared spectroscopy and gas-liquid partition chromatography.

But, furthermore, each perfume material must pass an even more rigid examination—the one under the sensitive noses of VAH's highly skilled perfumers. For the ultimate test of any fragrance, of course, is in its smell. Thus quality control at Union Beach is honed to a particularly fine degree.

▶ **Friedel-Crafts**—Here's a close look at four important fragrance-producing reactions at Union Beach—Friedel-Crafts, Grignard, condensation and hydrogenation—each run, essentially, as an independent chemical plant making its own product.

UNFOLD FLOWSHEET



DISTILLATION columns purify frangrances.

RIGOROUS TESTING insures top purity aromatics.

Far and away VAH's largest volume item, with output of some hundreds of tons/yr., is phenyl ethyl alcohol. It's produced via a Friedel-Crafts reaction.

Ethylene oxide and benzene are reacted in the presence of an aluminum chloride powder catalyst in a 1,500-gal., agitated and jacketed, glass-lined steel vessel. Cold brine, circulating through the jacket, keeps reaction temperature around 0-15 C.; excess benzene serves as a solvent medium.

From reactor, reaction liquor goes to a 5,000-gal. agitated tank where it's drowned in water. Then it passes to a 2,000-gal. tank for a further wash, this time with slightly acidic (HCl) water. Two 15-ft.-tall by 2-ft.-dia., ceramic-saddle-packed distillation towers strip out the excess benzene which recycles to the Friedel-Crafts reactor.

Final step before storage is the purification of the crude phenyl ethyl alcohol from the bottom of the second benzene-recovery column. This takes place in three, ceramic-packed vacuum fractionation columns, each 35-ft.-tall by 1-ft.-dia.

▶ **Grignard**—Because of the slightly hazardous nature of some of the reactions run in it, the Grignard facility is set at some distance from the main plant and completely out of doors. An example of one such synthesis is the manufacture of dimethyl benzyl carbinol which uses highly flammable ethyl ether for a solvent.

Benzyl chloride and acetone alternately feed with ethyl ether to a 200-gal., agitated and jacketed stainless steel reactor. Thin turnings of magnesium, forming the Grignard reagent, are added. Reaction runs at about 35-40 C., controlled by the joint action of cold brine passing through kettle jacket and the refluxing of ether solvent.

Liquor discharges to a water wash followed by an acetic acid wash in a 500-gal. tank. Then a 15-ft.-tall by 2-ft.-dia., ceramic-packed distillation column recovers ethyl ether for reuse. Crude dimethyl benzyl carbinol is purified by vacuum fractionation.

▶ **Hydrogenation**—Citronellol is made from oil of citronella via a high-pressure hydrogenation reaction.

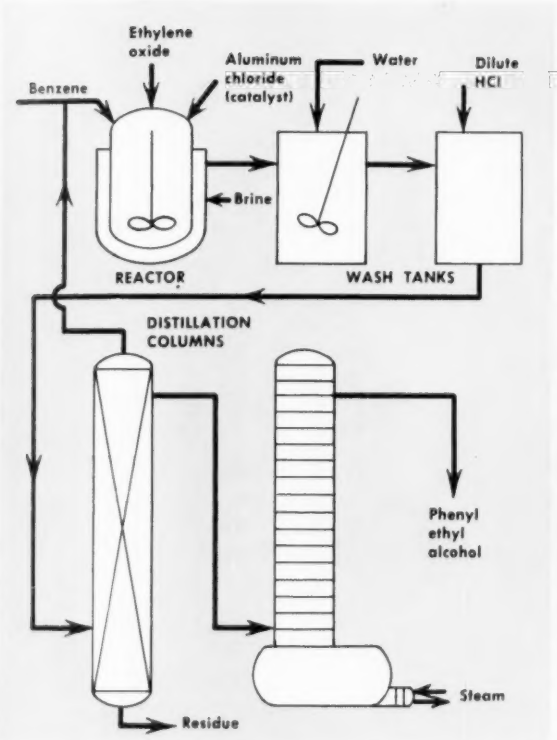
Reaction runs in a jacketed, 500-gal. steel autoclave fitted with a turbine type agitator. Citronellal (oil of citronella) and hydrogen react over a nickel (Raney) catalyst. Steam through reactor jacket brings reaction temperature to 80-100 C. and pressure runs around 200 psi.

Autoclave discharges through a leaf-type filter where the nickel catalyst is recovered. Crude citronellol is then purified by steam distillation in a batch still.

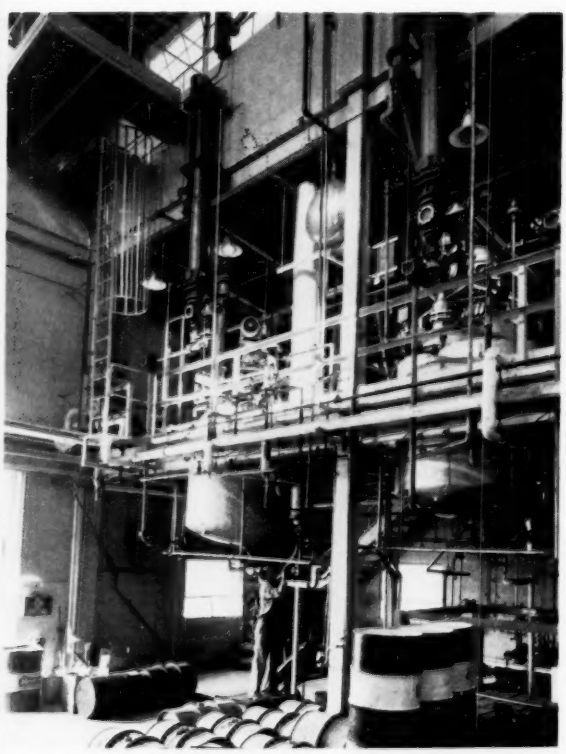
▶ **Condensation**—One important fragrance produced by a batch condensation reaction is amyl cinnamic aldehyde.

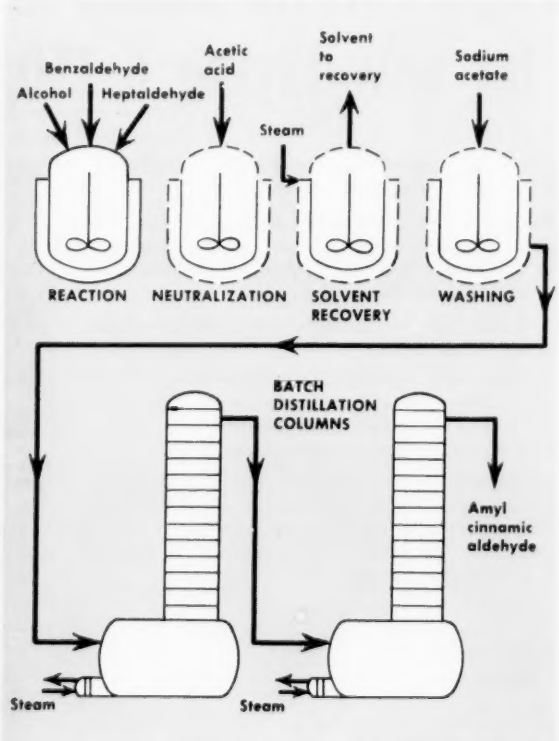
Benzaldehyde and heptaldehyde are reacted in an agitated, 2,000-gal. steam-jacketed vessel with alcohol serving as a solvent medium. After about 24-30 hr., the reaction is essentially complete. Reaction liquor is neutralized with acetic acid, then, with vessel serving as a still, the alcohol is driven off to recovery by steam in vessel jacket. An aqueous solution of sodium acetate, introduced to the same vessel, is used to wash the liquor.

Two stages of vacuum fractionation cut out the pure amyl cinnamic aldehyde.

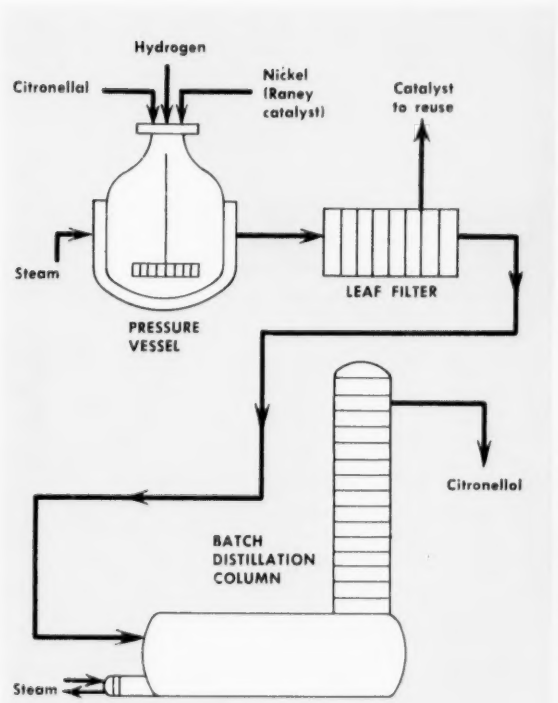


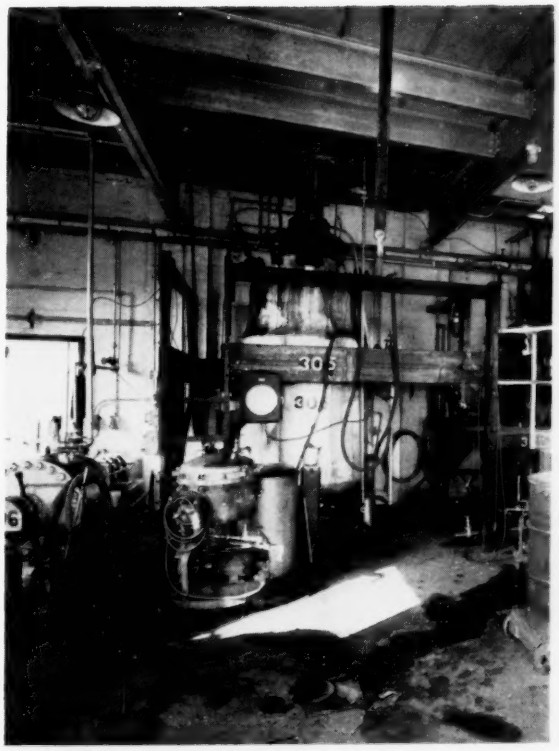
FRIEDEL-CRAFTS REACTION turns out VAH's single largest volume fragrance, phenyl ethyl alcohol.



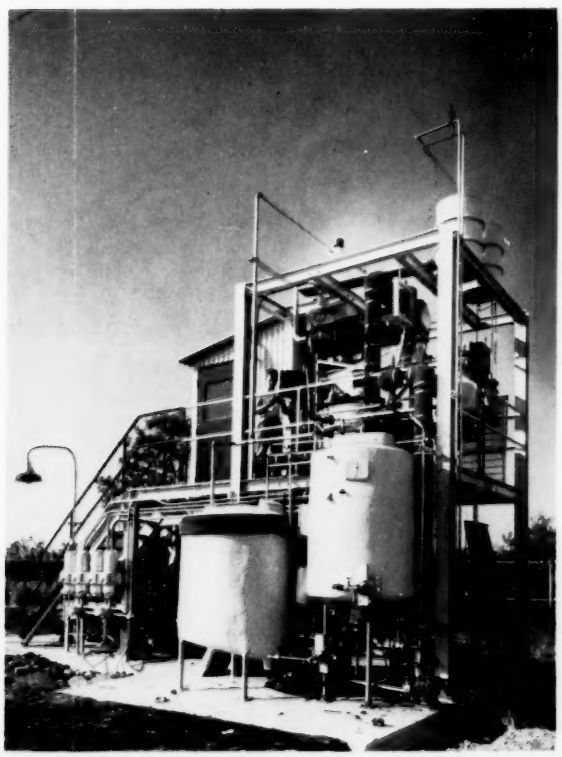


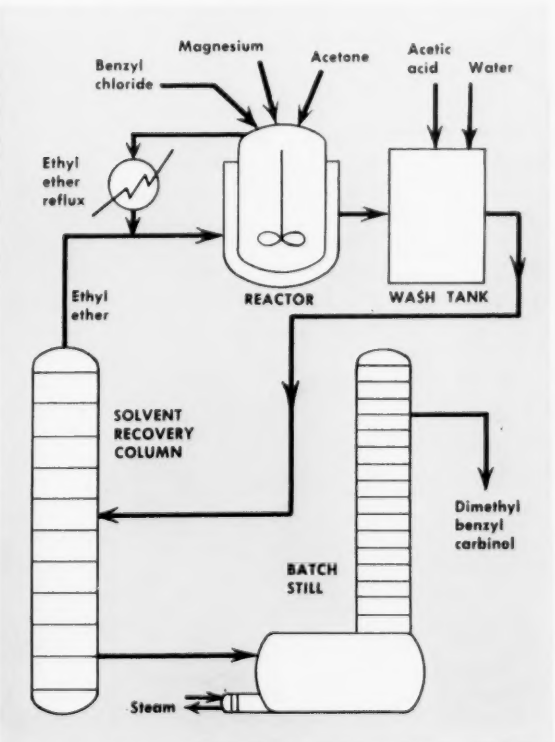
CONDENSATION REACTION between benzaldehyde and heptaldehyde gives amyl cinnamic aldehyde.





HYDROGENATION REACTION, run at pressures around 200 psi., converts citronellal to citronellol.





GRIGNARD REACTION, run in out-of-doors facility for safety, produces dimethyl benzyl carbinol.

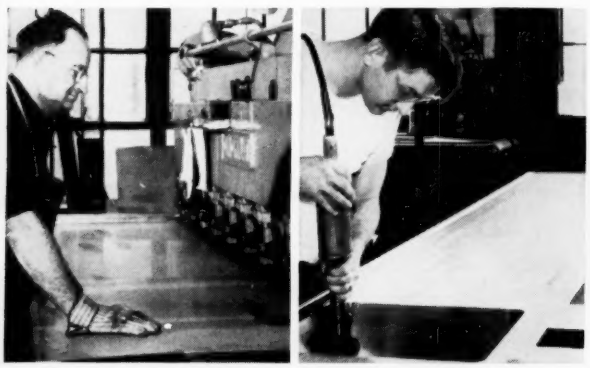
Competitive "Acid Test" Selects Carpenter Stainless No. 20Cb

To find out which grade of stainless steel would hold up best under attack by highly corrosive acids, a large manufacturer put his laboratory to work. The best performer was then selected as the steel to be used in table tops and sinks throughout his new materials testing laboratories shown above.

Carpenter Stainless No. 20Cb showed less weight loss than any other steel when subjected to mixtures of hydrochloric and sulphuric acids. Attack of the sulphuric acid was so slight that the spots easily wiped off. This super corrosion-resistant steel will withstand a wide range of laboratory acids in many concentrations and under varying temperatures.

Carpenter Stainless No. 20Cb advantages will pay off like this on any equipment. Money-eating corrosion can be stopped immediately and new economies will be built into your product performance. It's available as tubing, pipe, sheet, plate, strip, bar and wire through your nearest Carpenter distributor. The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

MEMBER



Shearing and buffing Stainless No. 20Cb sheet used for laboratory table tops and sinks.

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"

Carpenter

Stainless No. 20 & No. 20Cb

A dozen vessels built by Newport News were furnished under contract with C. F. Braun, Inc., of Alhambra, Calif., design engineers for the ultra-modern Delaware Flying A Refinery of the Tidewater Oil Company located 15 miles south of Wilmington.

Newport News builds 12 major components for new Flying A 130,000-bpd refinery

This is the Tidewater Delaware Flying A Refinery while under construction near Wilmington.

Newport News fabricated 12 of its major vessels — 2 of which are the largest such units ever built: a 250′ Orthoflow fluid "cat cracker" converter and a 225′ reactor scrubber of the fluid coker.

More notable than size, though, is the quality of the Newport News fabrication.

Coke-out screens in the reactor scrubber, for example, are made of 704 12% chromium segments. Welded together with accuracy, they provide 45% clear opening . . . with opening tolerances less than 1%.

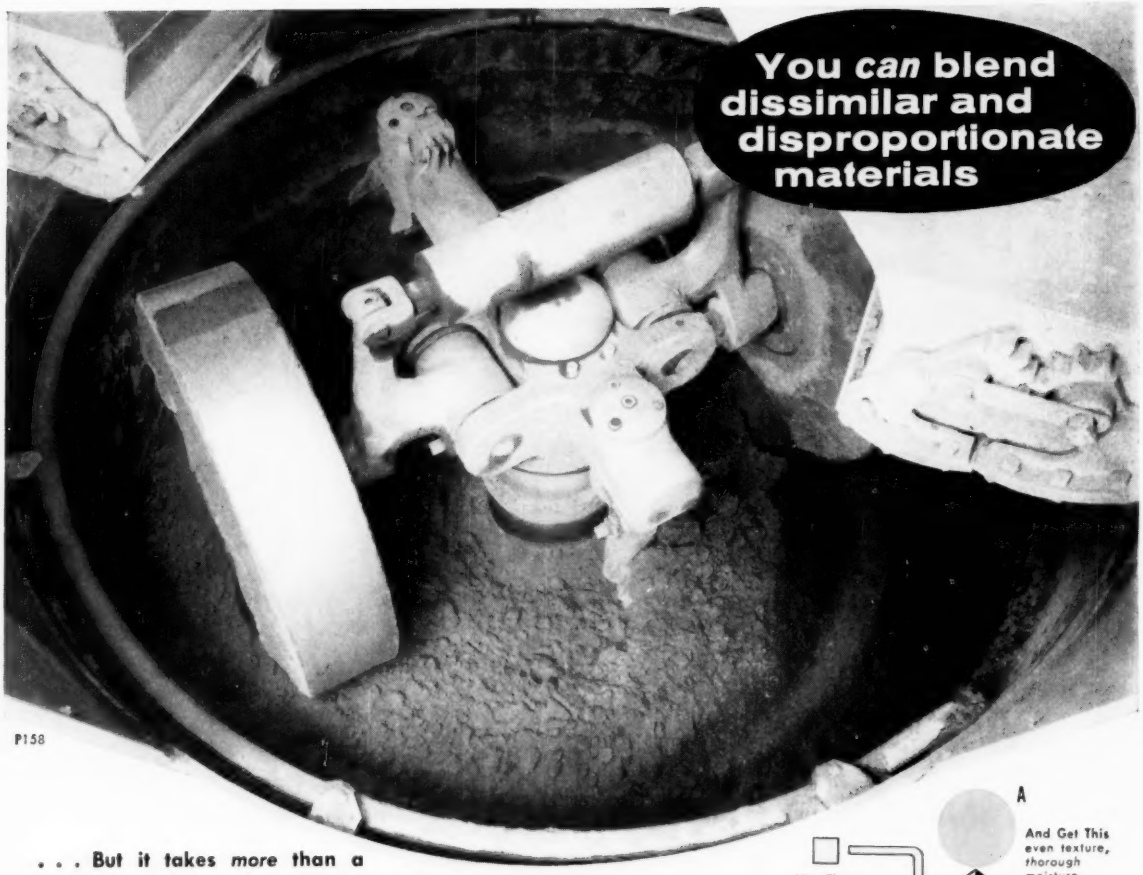
You get expert fabrication, the skill of specialists when Newport News builds your equipment. When you want reactors, pressure vessels, vacuum tanks and the like, sub assemblies or weldments in almost any size or shape, get a bid from Newport News.

Send for newly published, easy-to-read, illustrated booklet, "Facilities and Products". It describes the many ways in which Newport News can help you with present or future projects. Write for your copy today.

Full advantage was taken of the Newport News deep water loading facilities for transportation of all of the equipment by barge. Shop erection prior to shipment assured fast, trouble-free field assembly.

Engineers: Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

Newport News Shipbuilding and Dry Dock Company, Newport News, Virginia

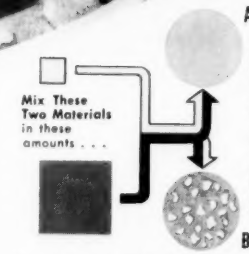


. . . But it takes *more* than a simple stirring, tumbling or agitator action.

In the Simpson Mix-Muller you get a unique three-way kneading, smearing, spatulate action. Materials are not merely stirred or tumbled together. It's an intensive and controlled *mulling* action which eliminates balling, breaks up agglomerates and actually *coats* one material with the other. Dispersion of moisture, binders or carriers is thorough, uniform and quickly accomplished. You get a mix that *stays* mixed, one that is unaffected in either storage or transit.

Want proof? Write for details on a confidential mulling survey on your own product . . . conducted under strictest laboratory conditions. Or write for literature.

SIMPSON *MIX-MULLER* DIVISION


A
And Get This even texture, thorough moisture dispersion
Mix These Two Materials in these amounts . . .
Not This "Hot spots", balling, uneven and wasteful dispersion.
B

Here's how *controlled mulling* works:

Diagram shows comparative results of blending a minute amount of one material with large amount of another material in (A) MIX-MULLER and (B) conventional mixer. Savings in raw material, reprocessing time and quality of finished product are the outstanding *rewards* of mulling your product.

NATIONAL ENGINEERING COMPANY
636 Machinery Hall, Chicago 9, Ill.

HOW MULLING gives you controlled dispersion for better blends:

GOING: Mix is wetted, dispersion of coating media begins as lumps form.

GOING: Smearing, *spatulate* action breaks up lumps as mulling action disperses moisture.

GONE: Agglomerates almost gone as blending nears completion. Mix is homogeneous, thorough

Chemical Engineering

Practice

FEB. 24, 1958

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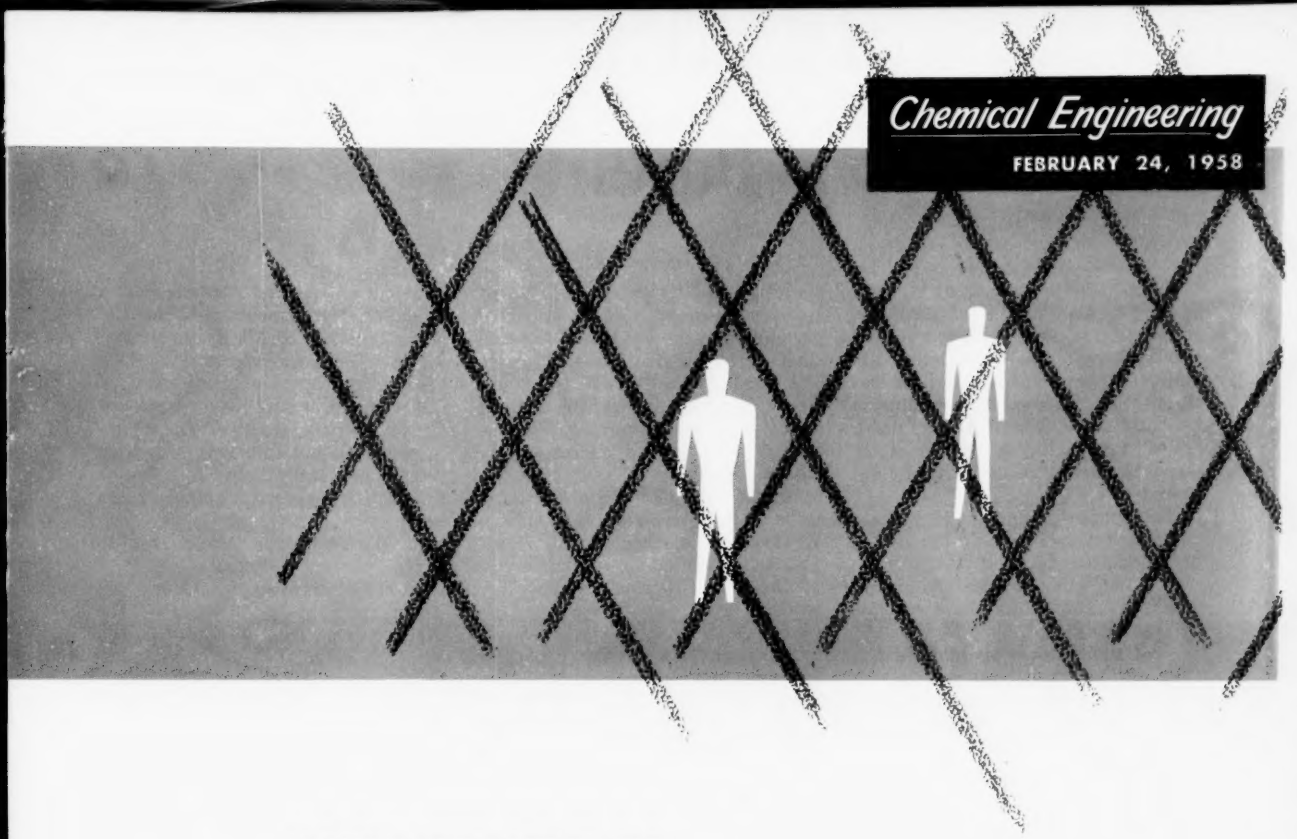
Fittings and Flanges

Chemical Engineering
FEBRUARY 24, 1958



NOW'S THE TIME TO . . .

Review Patent Fundamentals

Recent developments may threaten your entire engineering program. Will you be fenced out by some weakness in basic fundamentals?

ROBERT G. CROOKS, Arthur D. Little, Inc., Cambridge, Mass.*

IT'S A rare occurrence when a feature report in *Chemical Engineering* can qualify for "hot news" treatment. The typical report spends many months in the conception and gestation stages. We aim for complete, all-in-one-place, up-to-date coverage of a major chunk of engineering practice.

Our original idea for this report was to provide you with a thorough brushup on what you already know or should remember about the fundamentals of patent law. For those of you who learned your fundamentals before the patent laws were revised in 1953, this is also an appraisal of five years under today's statutes.

Now, suddenly, our subject has acquired a sense of urgency. A recently issued composition-of-matter patent, if upheld, may curtail the research, development, design, construction and sales programs of some of the most influential companies in the chemical process industries. Engineers and engineering managers are busy finding time to review their patent fundamentals. Patent attorneys are digging in for a long, hard battle. And the time you spend reading the next 15 pages may prove to be one of your wisest investments.—RFF

* Mr. Crooks is now with McMillan Industrial Corp., Ipswich, Mass. Meet your author on p. 175.

A CHEMICAL ENGINEERING REPORT

1. What Is a Patent?

United States patents, or "letters patent" as they are called formally, are documents issued by the United States Patent Office evidencing the rights of inventors—or their assignees—to exclude others in the United States from making, using or selling during a period of 17 years the inventions covered by the patents.

Each patent document includes:

- A detailed description of the patented invention.
- One or more numbered "claims" that define the invention in legal language.
- Usually, one or more drawings of the invention.

It's important to note that a patent does not of itself give an inventor the right to make, use or sell his own invention. It only excludes others from so doing.

In fact, it's rather common for the holder of a valid patent to be precluded from practicing his own invention because it falls within the scope of another patent, likewise perfectly valid, which is held by another person. This apparent paradox may be explained by considering patents in these terms:

A patent is a "fence" which enables its owner to prevent others from "trespassing upon" the invention defined by the claims of the patent. However, if the respective fences of Inventors B and C happen to be in turn enclosed by the fence of Inventor A, then B and C will themselves be unable to gain access to their own fences without first getting the permission of Inventor A.

Although B and C may prevent A from making, using or selling the inventions of B and C, Inventor A may—if he desires—prevent Inventors B and C from making, using or selling their own inventions.

Such a situation may arise, for example, if Inventor A makes a basic invention and obtains broad patent coverage, corresponding to a fence that encloses a comparatively large area. Later, Inventors B and C make improvements that use the basic principle of A's invention but which alter the features of A's invention in relatively minor ways.

Inventors B and C may be entitled to patents upon their improvements, but they may still have to obtain permission of Inventor A to use the basic principle set forth in his patent. Or else, they may wait patiently for A's patent to expire.

In this kind of situation, A's patent is said to "dominate" the respective patents of B and C.

In the Beginning

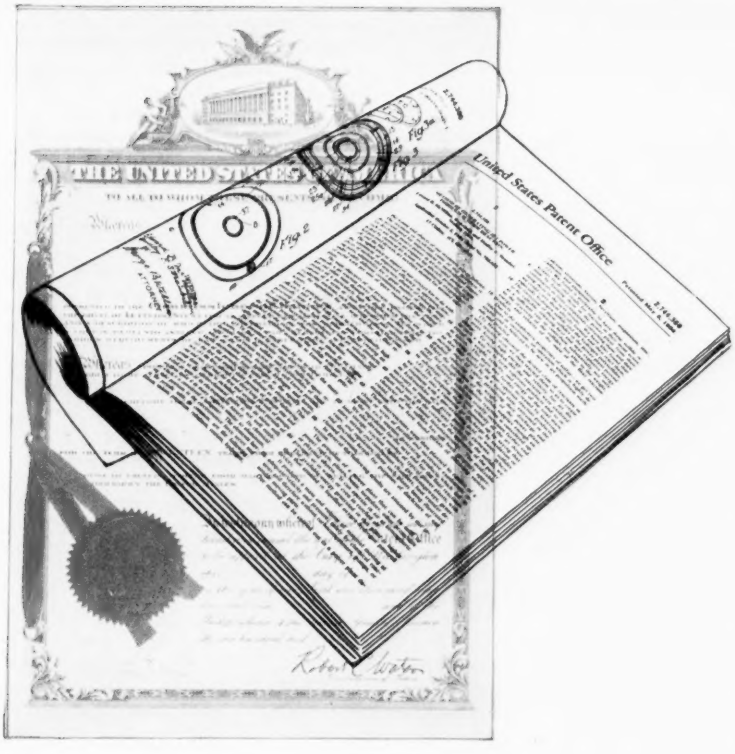
A number of early "letters patent" were granted by the sovereigns of Great Britain and were so called because they were not sealed up, but were left open—or "patent"—with the Great Seal hanging ornamentally at the bottom.

Some of these early "letters patent" were granted not for inventions but as royal favors. This permitted the patentees to have monopolies in particular businesses such as, for example, the manufacture of playing cards within the realm. The British people became so resentful of these trade monopolies that a "Statute of Monopolies" was enacted in 1624, prohibiting the granting of monopolies except for new inventions. It was felt that nobody should be granted even a temporary monopoly in any field unless he contributed a new invention which would eventually fall into the public domain and benefit everyone.

A Constitutional Right

The Constitution authorizes Congress ". . . to promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries; . . ." This constitutional provision is the basis for our copyright and patent statutory law, which has been enacted by the Congress.

While the first patent statute was passed in 1790, there have been revisons from time to time. And



the latest version is a codification of the statutory patent law which took effect on Jan. 1, 1953. Public policy underlying our constitutional provision and all the statutory patent law is that which was embodied in the British Statute of Monopolies.

Specifically, the public interest is best served if monopolies are granted in general only for new and useful inventions, and even then only for limited times. Thus, inventors are encouraged to make inventions and to disclose them to the public by means of patents, rather than to suppress the inventions or keep them secret. In return for the disclosure of an invention, our government grants to the inventor the right to exclude others from practicing his invention during the term of the patent.

When the patent expires, the invention becomes public property. Since the government—through the Patent Office—issues a patent only after it has been ascertained, so far as is practicable, that the inventor has disclosed a new and useful invention, we can draw an analogy between a patent and a contract.

If the inventor expects to receive a valid patent, he must make a full disclosure of a new and useful invention in its best form. If he tried to get a patent on his invention without disclosing some important aspect of the invention, he would be committing a fraud upon the public. Because upon expiration of the patent the public would not derive full benefit of the invention.

Should the inventor default upon his obligation to make an adequate disclosure of his invention for the patent, the contract analogy leads us to the correct conclusion that the inventor is not entitled to even a temporary monopoly. A patent on the invention should, in such a case, be denied and any patent which might inadvertently be issued would be invalid.

Monopolies vs. Antitrust Laws

Grant of a monopoly by our government is considered to be against public policy unless the grantee discloses a new and useful invention or unless there is some compelling reason for this grant.

So, not only is the grant of a nonpatent monopoly in general contrary to public policy, but also the federal antitrust laws make it clear that a privately contrived monopoly is, in general, likewise contrary to public policy and illegal; because such a monopoly usually deprives the public of the opportunity to continue some activity.

On the other hand, a temporary patent monopoly is justified because the inventor contributes something new which, prior to his invention, was not available to the public. Unlike the holders of the old British trade monopolies, inventors add something to the store of available technology. Therefore, they are entitled to temporary monopolies on their contributions.

What's in a Patent?

Although the makeup of a patent varies considerably, here's what a typical patent as issued by the U. S. Patent Office may include:

- A title.
- Drawings of the invention, if it can be illustrated.
- Names of the inventor and of the assignee, if any.
- A brief paragraph stating the field to which the invention relates.
- An explanation of the problem to be solved.
- The object of the invention (solution of the problem).
- A brief statement of how the problem is solved by the invention.
- Brief descriptions of the drawings, if any.
- A detailed description of the invention.
- One or more claims defining the invention in legal terminology.
- A list of references cited by the Patent Office during the pendency of the application upon which the patent was granted.

Thus, the two main purposes of the patent document are: to make a full disclosure of the invention to the public; to define in legal terms the invention which is to be the subject to the temporary monopoly.

What a Patent Claims

Defining an invention in legal terms is fulfilled by claims, which may be said to be the heart of a patent. The claims, interpreted in the light of the drawings and the detailed description, locate the "fence" by which the inventor is to exclude others from making, using or selling his invention.

Although some patents (for example, for certain chemical inventions) are not susceptible of pictorial representation and do not

include any drawings, all patents do include at least one claim.

Patent claims are usually written in a particular type of legal phraseology. Here's how we might claim the invention of a simple chair:

1. A chair comprising a substantially flat member oriented in a generally horizontal plane above the floor in such a manner as to permit said substantially flat member to offer vertical support to a human body, a plurality of legs fastened at their respective upper ends to said substantially flat member and adapted to rest at their respective lower ends upon the floor, and a back member fastened near one end to one edge of said substantially flat member, said back member extending upward from said substantially flat member in such a way as to provide horizontal support to the upper portion of a human body.

And that's only for a *simple* chair.

Since each patent is supposed to cover only one invention, it may seem strange that patents usually have more than one claim. A patent may contain a large number of claims because an inventor is entitled to define his invention in a number of different ways. This discourages evasion of his patent "fence" by persons who may seek to "trespass upon" the subject matter of the invention without the inventor's permission.

Rather than relying upon a single claim, an inventor—through his attorney—usually defines the boundaries of his invention in several different ways by several claims, individually numbered, which are printed close to the end of the patent document. The several claims are usually of different scope, or breadth. They are like closed fences which may overlap each other and which respectively enclose somewhat different areas, but each of which encloses some ground that is also enclosed by one or more of the other fences.

You should remember that the broadest patent claims are not the ones that contain the most "elements" or "limitations." They are likely to be the ones that contain the fewest.

While, in general, the shortest claims have the fewest limitations (and hence, are the broadest), patent claims must be read with care. There is always the possibility that lengthy clauses in some of the longer claims may be mere window dressing which does not appreciably cut down the area enclosed within the claim "fence."

Conversely, a single limitation within a short claim may by its nature so curtail the breadth or scope of the claim that very little area remains within the fence. To illustrate, consider Claim 1 given above for the simple chair. We have here a relatively long claim, but nevertheless a claim that is rather broad in scope.

Now consider Claim 2, below, which is short but very restricted in its scope:

2. A chair painted with phosphorescent material so as to glow in the dark.

Note that Claim 1 "reads on" or comprehends nearly every conventional chair having a back, whether the chair has three, four or more legs, and whether the chair has arms. It's important to realize that armchairs are within the terms of Claim 1 despite the fact that the claim makes no mention of arms.

We can explain this apparent paradox by pointing out that for a patent claim to "read on" an object, it's necessary only that every element of the claim have a counterpart in the object, not that every element of the object have a counterpart in the claim.

Considering Claim 2, note that despite the brevity of the claim, the scope is narrow.

You might ask why an inventor would want to have claims of different scope in his patent. Why doesn't an inventor simply direct his attorney to draw a single claim which is as broad as possible, a claim that "reads on" the largest possible number of devices that the inventor's competitors would like to use?

There are several answers to this question. While your attorney will try to secure a patent that contains at least one such broad claim, he will recognize that any single fence he may build might turn out to be not completely burglar-proof; and that a higher degree of protection may be afforded by a multiple fence, even though the fences may not all be strictly concentric.

Your attorney is likely to draw several claims defining the invention in different phraseology, and also to include some claims which are narrower in scope than the claim which is thought to be the broadest one obtainable.

Although the claims in a patent as issued by the U. S. Patent Office are said to be *"prima facie* valid," there is always the possibility that one or more claims of a patent—especially the broadest ones—will in later litigation be found to be invalid and void. Therefore, it's good practice to be certain that a patent contains some claims of relatively narrow scope, which will serve as a second or third line of defense in case the broadest claims are struck down by the courts or proved invalid by other means.

Remember that each claim in a patent, in order to be valid, must describe the invention which is the subject of the patent. Each such claim must *not* read on the "prior art," anything that was known prior to the invention which is the subject of the patent.

Each claim that contains a limitation that is not applicable to anything in the prior art will not "read on the prior art." Although being readable on the prior art is the most obvious defect which renders a patent claim invalid, there are other grounds on which a claim may be found invalid.

Generic vs. Specific

In addition to the desirability of having a second line of defense, there are other reasons which prompt your patent attorney to include a number of different claims in each patent application.

Under certain circumstances, an invention may be claimed in its generic form and also in the form of up to five different species in the same patent; so long as a generic claim can be presented which reads on all the species, but does not read on the prior art.

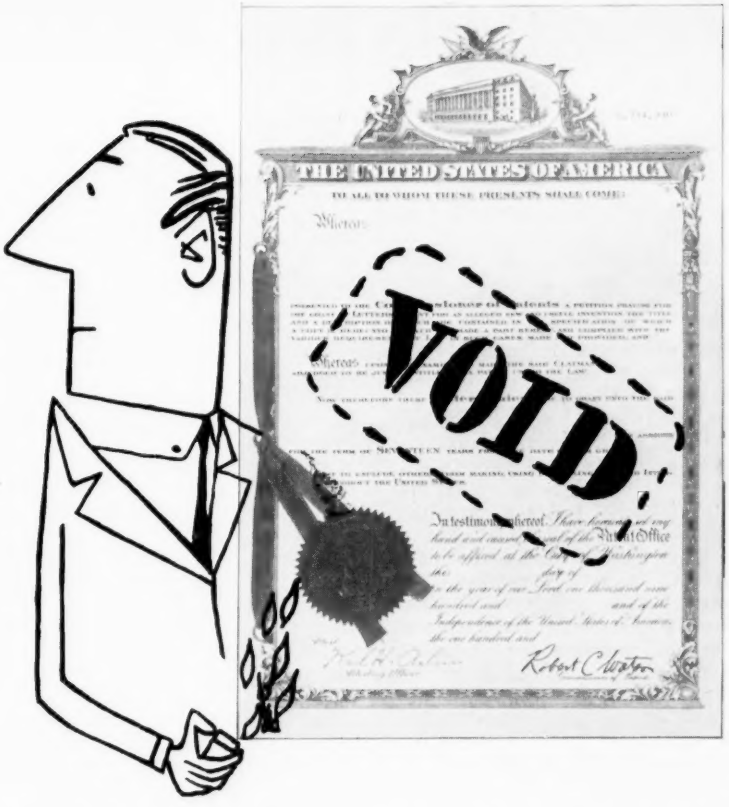
Moreover, under certain circumstances it's possible to claim in the patent an apparatus and a method for using the apparatus, or an apparatus and certain subcombinations of the apparatus.

We can illustrate this with the following claims, which might have been obtained in one patent if the first inventor of the vacuum tube had, as part of his invention, conceived that vacuum tubes might be fitted with two, three, four or more electrodes:

Generic Claim—1. A discharge device comprising an evacuated envelope and a plurality of electrodes within said envelope.

Specific Claim, Diode—2. A discharge device comprising an evacuated envelope and two electrodes within said envelope.

Specific Claim, Triode—3. A dis-



charge device comprising an evacuated envelope and three electrodes within said envelope.

More Specific Claim, Triode—4. A discharge device comprising an evacuated envelope and three electrodes within said envelope, said three electrodes including an anode, a control grid and a cathode assembly.

Subcombination Claim, Cathode Assembly—5. A cathode assembly for a discharge device, said cathode assembly comprising a heater and a tube concentric with said heater, said tube being coated with electron-emissive material.

Specific Claim, Pentode—6. A discharge device comprising an evacuated space between two electrodes within said envelope.

Method Claim, Operation of Triode—7. A method of governing the flow of electrons through an evacuated space between two electrodes having different potentials, said method consisting in controlling the potential difference between one of said two electrodes and a grid electrode interposed between said two first-named electrodes.

Once again, we want to emphasize that each patent claim, to be valid, must first have a basis in the descriptive portion of the patent. Second, it must "distinguish patentably from the prior art."

It would seem to be an easy matter to determine whether or not these two criteria are satisfied, but the record of patent litigation in the courts shows that such a determination is often very difficult.

A patentee must remember that, despite the beautiful blue ribbon and red seal that accompany the formal patent document issued by the U. S. Patent Office to the inventor or his asignee, there is always the chance that a patent will later be found not to give the protection which it purports to give.

Care by the inventor, his attorney and the Patent Office can minimize this risk, but never eliminate it completely.

How to Read Quickly

People who work with patents, or who desire to avoid conflict with adversely held patents, frequently find it necessary to appraise a large number of patents quickly without taking time to study any of them thoroughly.

A preliminary appraisal of a patent can usually be accomplished rather quickly if attention is given to just a few key portions of the patent. This will help you determine whether further study is warranted.

In the case of a patent for a piece of equipment, here are the key portions of the patent:

- Look at the title.
- Look at the drawings. Every feature claimed should be illustrated in the drawings.
- Read the first paragraph of the patent: "This invention relates to," etc.
- Read the brief statement of the invention, often to be found immediately following the statement of the objects of the invention.

If the patent appears to be pertinent, look at the claims before you spend time studying the detailed descriptive material.

For Chemical Patents

In the case of a chemical patent —which may possibly have no drawings—here's how to make a quick appraisal:

- Look at the claims after looking at the title. The claims may contain graphic formulas which clearly set forth the invention.
- Read the examples of the invention, as set forth in the detailed descriptive material.

If it becomes necessary to study the claims in order to determine whether any given apparatus or process infringes them, remember that any patent claim containing an element or limitation not having a counterpart in the given apparatus or process is ordinarily not infringed by that apparatus or process.

Often you will find it helpful to underline the limitations in each claim that do not read on the given apparatus or process. If there happens to be one such limitation which appears in all the patent claims, the patent may in general be disposed of as not applicable to the given apparatus or process.

Another point to be considered in the quick appraisal of a patent is the notation of the assignee, if any, of the patent. If there is such a notation, it will indicate the owner of the invention at the time of issue of the patent.

Usually, one must go to the owner of the patent in order to secure the right to make, use or sell the patented invention.

2. What's a Patentable Invention?

In the first section of this report we said that it's often very difficult to determine whether or not a given claim should be upheld as a valid patent claim.

This statement is true not only during consideration of a proposed claim before a patent incorporating it has been secured, but also after the issue of such a patent, when the scope and validity of the patent may be in controversy in negotiations or in court.

For a claim to be incorporated in a patent and to command the respect of those who operate in the field to which it pertains, the claim must define an invention which satisfies all of the following five requirements:

1. The invention must fall within the classes of patentable subject matter as enumerated in the patent statute.
2. The invention must be useful.
3. The invention must be new, or "novel."
4. The invention must not have been obvious at the time it was made.
5. The invention must not be subject to any other one of the so-called "statutory bars" to patentability, which are enumerated in the patent statute.

We want to emphasize that an invention, in order to be validly patentable, must satisfy all five of these requirements, each of which now warrants further discussion.

Must Be Patentable Class

Our patent statute lists processes, machines, manufactures, compositions of matter (as well as improvements falling into these four classes), certain plants (of biological species, that is) and certain ornamental designs as the only classes of subject matter which can be patented.

The word "process" is used interchangeably with the words "art" and "method," and is said to include the new use of a known process, machine, manufacture, composition of matter or material. However, it's not safe to conclude that every such new use is patentable. A patentable new use must itself be a genuine process which satisfies all the other requirements for patentability as outlined in the following discussion.

"Machine" is interpreted to include not only mechanisms but also such things as new electrical circuits, which are such as to have an inherent "rule of action." The word "manufacture", on the other hand, is interpreted to mean objects which may be said not to have an inherent rule of action, such as objects not characterized by appreciable relative motion between their parts. A conventional chair is an example of a manufacture.

The term "composition of matter" includes mixtures and compounds not found in nature. In patent terminology, the word "plant" includes non-tuber-propagated, asexually reproducible plants, bushes and trees; while the word "design" includes the ornamental and decorative appearance which may characterize an article of manufacture. The word "design," in the patent sense, does not refer to the product of engineering calculations, but rather to artistic appearance.

Having enumerated the allowable classes of patentable subject matter, we may notice that such things as physical principles and business-promotion schemes are not included among the permissible classes. It may be of interest to point out that Samuel F. B. Morse's U. S. Patent 1,647 on the telegraph principle was held to be partially invalid because one of the patent claims was so broad as to encompass all use of the physical force of electromagnetism for transmitting and recording information between distant locations.

Likewise, Dr. William Morton's U. S. Patent 4,848 on the use of ether for anaesthetic purposes was held to be invalid as depending on the mere observation of an inherent property of a well-known substance. The Morse and Morton cases illustrate the fact that no matter how useful and beneficial to mankind, an invention must fall within the

statutory classes of subject matter to be validly patentable.

Must Be Useful

In order to qualify as being validly patentable, an invention must have some degree of use for some purpose which is not immoral.

The invention need not necessarily be economically practicable or a business success, but it should be operative to fulfill some reasonably useful purpose. Certainly, perpetual-motion machines and other devices which allegedly operate in violation of some physical law do not satisfy this criterion.

Must Be New or "Novel"

As set forth in the patent statute, an invention is not validly patentable if it "was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent."

The words "printed publication" may be explained by saying that a printed publication in the patent sense usually take place when a document is made available to the public, whether the document is typewritten, lithographed, printed on a press or produced by any other means. If a document is placed in a public library and listed in the card file, it becomes a "printed publication" whether or not any visitor to the library ever sees it.

Similarly, descriptions appearing in trade circulars or catalogs are printed publications if circulated to the public.

It's interesting to note that one who in good faith believes himself to be the first and original inventor may be awarded a valid United States patent even though the same invention was previously made by another person in a foreign country. If the invention was publicly known or used in this country, however, no amount of good faith on the part of a later "inventor" will enable him to secure a valid United States patent on that invention.

Must Not Be Obvious

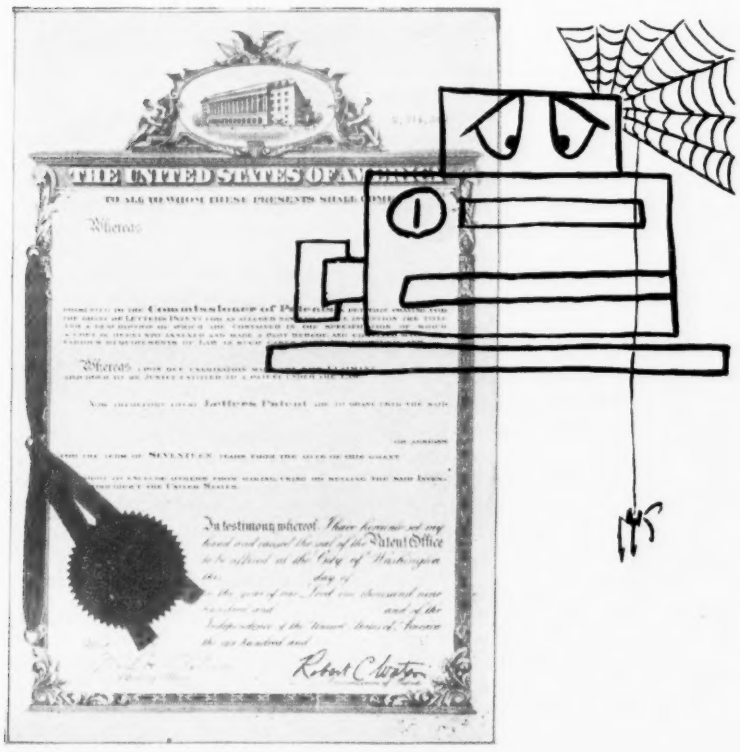
To be patentable, the invention must not have been obvious at the time it was made. This particular requirement for valid patentability of an invention is one of the most troublesome of all the requirements because it's so difficult to apply.

Since certain inventions might be obvious to some persons but not at all obvious to others, it has been necessary to postulate a hypothetical "person having ordinary skill in the art to which said subject matter pertains," and to try to decide whether the invention would have been obvious to such a person at the time it was actually made.

If the invention would have been obvious to the "person skilled in the art," aware of all previous work done in that field, then the invention cannot be the subject of a valid U. S. patent. Of course, hindsight is always better than foresight and it's often difficult in appraising an invention or a patent to put oneself in the position of the inventor at the time he made the invention.

For instance, a court (perhaps unconsciously taking advantage of its after-acquired knowledge) held a basic Marconi radio patent (763,772) invalid in the belief that the invention should have been obvious at the time it was made.

Even today, after the 1953 codification of the patent law, there is still much controversy concerning the standard of invention required to support a valid patent.



Must Avoid Statutory Bars

To be patentable, the invention must not be subject to any of the so-called statutory bars to patentabilty. As spelled out in the patent statute, a valid patent cannot be secured on an invention if:

- The invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States.
- The inventor "has abandoned the invention."
- "The invention was first patented or caused to be patented by the applicant or his legal representatives or assigns in a foreign country prior to the date of application for patent in this country or an application filed more than 12 months before the filing of the application in the United States."
- "The invention was described in a patent granted or an application for patent by another filed in the United States before the invention thereof by the applicant for patent."
- The applicant for patent "did

not himself invent the subject matter sought to be patented."

We would like to emphasize that any one of these statutory bars is sufficient to preclude the grant of a valid patent. If a patent should inadvertently be granted despite the applicabilty of one of these bars, the patent would be invalid.

In the first statutory bar listed above, the words "public use" warrant a little clarification. In general, if an invention is used—either by the inventor or another—for commercial purposes, the invention is in "public use." And this applies even though the invention may actually be used in a locked room accessible only to one person.

However, it has been held that if an invention is used only for evaluation and experiment but not to make money, the invention is not in public use even though many persons may come in contact with it.

Having Been Abandoned . . .

Turning to the second statutory bar, abandonment of an invention may likewise require a little clarification. If an inventor makes an invention and simply neglects to apply for a patent for a considerable period of time, he will not ordinarily be held to have abandoned his invention.

However, if he performs some affirmative act tending to show that he considers his invention to be worthless, he may be held to have abandoned his invention. For instance, if a manufacturer of synthetic dyes invents a process for synthesizing a particular dye but then goes into production of the dye by means of another process, he may be held to have abandoned the process which he invented.

Another way in which an invention may be held to have become abandoned is by any unsuccessful attempt to keep the invention secret while deriving benefits therefrom. If an inventor of a process for synthesizing a dye should practice the process in secret, intending to have a permanent monopoly of the process by secrecy instead of a temporary monopoly by seeking a patent, the inventor would run the risk that the secret might leak out, leaving him unprotected.

Should the inventor apply for a patent at this point, and should the facts described above become known, the inventor would be held to have "constructively" abandoned his invention and forfeited his right to patent protection.

First Come, First Served

The fourth statutory bar prevents Inventor A from receiving a valid patent only if his invention is found to be described in a patent granted to Inventor B on an application filed before A made his invention.

If this is not the case, A will be permitted to show that he made his invention before the filing date of B's application, on which B's patent was granted. If B had in his patent *claimed* the invention in question as well as describing it, A and B would be likely soon to find themselves in an interference proceeding to determine who was the first inventor of the invention claimed by both.

The fifth statutory bar mentioned above seems almost self-evident. Although a U. S. patent may legally be issued to an assignee of the inventor, the application for the patent must—with very limited exceptions—be filed by the inventor himself. The inventor makes an oath to the effect that he believes himself to be the "first and original" inventor of the subject matter in question.

If, for some reason, the patent application is not filed by the true inventor, any patent issuing thereon will be invalid.

Anyone who "puts his invention in someone else's name" is making a serious mistake no matter how laudable may be his motives for so doing. In as much as determination of the correct inventorship is sometimes difficult, the law makes provision, under certain conditions, for correction of a patent so that the patent document will state the inventorship properly.

Negative Invention Tests

We have explained that there are five positive requirements which must be satisfied in order for an invention to be validly patentable. However, you should not conclude that every invention which apparently satisfies all five of these requirements as stated is a validly patentable invention.

In addition to the five positive criteria for testing the patentability of an invention, there are a series of what might be called "negative tests" of invention. Each of these negative tests, while not an inflexible rule of law, states a type of advance in the art which is not, in general, patentable.

While these negative tests may be considered to qualify the statutory requirement of non-obviousness, the tests themselves are based upon policy rather than upon statute. Furthermore, there are many exceptions to some of the tests.

Changing the Size

In general, changing the size of an object or machine or a component thereof is not a patentable step.

However, this rule is subject to the qualification that if a change of size produces a change of function which is surprising and seemingly out of proportion to the change of size, then the change of size may possibly be patentable.

A familiar illustration of this qualification is Edison's incandescent lamp, which was the subject of a patent that was adjudicated valid. Edison found that by simply using a filament half the diameter of similar filaments used with little success by other experimenters, he was able to make an incandescent lamp which had a useful life many times as long as those of lamps built by the other experimenters.

Thus, by an apparently simple change of dimension, he achieved a change in function that was far out of proportion to the change of filament dimension, permitting him to succeed where others had failed before him.

There is a similar rule to the effect that changes in degree of purity of materials are not, in general, patentable. Once again, the rule should be applied with caution as illustrated by the fact that the Hoffman aspirin patent was held to be valid. Hoffman simply found that by purifying acetylsalicylic acid sufficiently, a well-known compound could be changed from a hitherto useless substance to a very useful drug.

Changes of material are not usually patentable unless the invention is a new composition of matter or unless, as in the aspirin case, some new and surprising result is obtained.

Aggregation vs. Combination

If you put together two or more familiar objects to make a new object or machine that will perform no function other than the sum of the functions of its components, the new object is called an

"aggregation." An aggregation can not be validly patented.

The classic example of an aggregation is the Faber eraser-equipped lead pencil. In the lead pencil with an eraser at its end, said the court, the pencil does no more than to write as it did before being equipped with an eraser; while the eraser does no more than erase as it did before being mounted on a pencil. Therefore, the Faber patent was found to be inavlid.

If the pencil and the eraser had somehow been made to coact to perform some function which they were not individually capable of performing, the result might have been a validly patentable "combination" rather than the aggregation upon which the patent was struck down.

An imaginative judge has drawn an analogy to illustrate the difference between a combination, which may be patentable, and an aggregation which is ordinarily not patentable. A football team, said the judge, is a combination whereas a track team is an aggregation.

The football players work together on each play to advance the ball by means of blocking and deception far beyond the capabilities of all eleven players operating individually. Each of the track athletes, on the other hand, runs his respective race or participates in his respective field event pretty much as an individual, and cooperates with his teammates only to the extent of contributing to the team score the points he earns.

Upon the basis of this analogy, we are led to the conclusion that a battery of drill presses, for example, each of which operates in response to a common control handle, would probably not qualify as a patentable invention. However, a single drill press of a new and useful type, made up of parts which effiectively coact, might be the subject of a valid patent.

Doctrine of Equivalents

In general, if you replace a part of a combination with another part which performs substantially the same function in substantially the same way to produce substantially the same result, the new part is not patentable.

Moreover, the new combination is not validly patentable over the old combination. This principle is a form of statement of the so-called "doctrine of equivalents" and is another of those principles of patent law which are easy to state but often hard to apply.

There is another principle, closely related to the doctrine of equivalents, which can be stated in these terms. If you make a patentable improvement upon a component of a combination, such that the improved component performs substantially the same function in the combination as did the old component, the combination itself will not in general have undergone a validly patentable change.

To illustrate this principle, if you replace the starter of an automobile with a better starter, the automobile equipped with the newly invented starter—but otherwise not changed—will in all probability not be patentable as a new combination. This principle has been referred to as the rule of the "exhausted combination."

Other Negative Tests

Merely making a device portable is not usually a patentable step, nor is the use of an old material or device for a new purpose patentable if the new purpose is analogous to the old purpose.

Once again, this is a rule which is easier to state than to apply, because the term "analogous purpose" defies precise definition.

One final negative test of invention may be simply stated as follows: Objects and materials found in nature are not patentable, nor are artificial duplicates of such objects and materials. However, a method for producing such artificial duplicates may, perhaps, involve invention and be patented.

In summary, the question of whether or not an invention can be validly patented is often difficult to answer. In particular, the requirement that an invention not be obvious is especially troublesome because there are as many subjective standards of obviousness as there are people.

In doubtful cases, a decision on the question of obviousness must necessarily be influenced by such factors as the magnitude of the problem solved by the invention and the length of time the problem existed before being solved. If a serious problem existed for a long period of time, there seems to be at least some evidence that the solution of the problem was not obvious.

3. Preparing an Application

Issued patents, of which printed copies are available from the U. S. Patent Office, are published by the government; but they are written by the respective inventors, their attorneys or agents.

The document which becomes the patent, in each case, was originally prepared as a major portion of an application filed in the Patent Office by the inventor or on his behalf. Although an inventor may prepare and file his own patent application, the more usual practice is for an inventor to disclose his invention to a patent attorney or patent agent, who in turn prepares the patent application.

Then, he files it in the Patent Office in Washington, D. C., and performs whatever further acts may be necessary to secure the issuance of a patent upon the application—or to reach a final determination that a patent cannot be issued thereon.

The Inventor Discloses

Assuming that the application is to be prepared by the inventor's attorney, the first step is for the inventor to describe his invention as thoroughly as possible to the attorney.

It's particularly important for the attorney to understand fully the problem that is solved by the invention and the ways, if any, in which the problem has been handled previously.

Of course, he should understand fully the precise improvement which characterizes the invention as compared with the prior art. The importance of a full disclosure of the invention and discussion of its background can hardly be overestimated. Unless the attorney gains a full insight into the problem solved by the invention and the ways in which any prior solutions of the problem have been deficient, the attorney is likely to be unable to draft the patent application in such a way as to secure fullest protection for the invention.

One of the most important contributions that an inventor can make in helping his attorney to obtain satisfactory patent coverage is to sit down with his attorney, after the latter has familiarized himself with the invention and its background, to try to foresee all possible variations.

The attorney's duty to the inventor is to attempt to draw the patent application in such a way as to include all possible variations which are properly within the scope of the invention. If the patent claims were not drawn in such a way as to "fence in" all possible variations, the way would be left open to other persons to secure the benefit of the invention without "trespassing upon" the area within the fence, thereby rendering ineffective any patent which may be obtained upon the application.

During the cooperative effort between inventor and attorney in trying to imagine all possible variations, the attorney is likely to ask the inventor a great many questions as to ways in which the invention might be altered and still fulfill its purpose. One of the attorney's principal objectives is to learn whether the thing which the inventor regards as his invention might in fact be merely one example of a much broader invention. If this is so, the attorney must discuss the broad aspects of the invention in the patent application and draw at least one claim broadly enough to cover the genus as well as the species.

Assuming that it has been decided, on the basis of a patent search or otherwise, that the invention is indeed novel and that the prospective benefits to be derived from a patent justify the expense to be incurred in soliciting the patent, the next step to be taken is the preparation of the patent application itself.

Parts of an Application

In the first section of this report we enumerated the parts of a typical U. S. patent. An application for patent includes most of the same parts in typewritten form and, in addition, includes an oath,

a power of attorney, a petition and a filing fee.

In the oath, the inventor swears that he believes himself to be the first and original inventor of the invention disclosed and claimed in his application; and that none of the statutory bars to patentability is applicable to his invention.

If the invention was made by only one person, it is a "sole" invention and the oath is executed by that person alone. On the other hand, if the invention was made by more than one person, it is a "joint" invention and the oath must in general be executed by all such persons.

If one of the inventors has died since making the invention, the oath must be executed in his behalf by a personal representative such as the executor of his will. In the case of an inventor who has assigned or contracted to assign his invention to another, such as the inventor's employer, but refuses for some unjustifiable reason to execute the oath, provision is made for execution of the oath in behalf of the inventor.

Two other instruments which accompany the oath and which may, in fact, appear with the oath upon a single sheet of paper are the power of attorney and the petition. By executing the power of attorney, the inventor gives his attorney or agent the power to take whatever lawful steps may be necessary to secure a patent upon the invention covered by the application. By executing the petition, the inventor requests that such a patent be issued to him.

If the patent application is to be assigned by the inventor to another, such as the inventor's employer, an instrument of assignment may be executed by the inventor with the application.

The specification, claims, formal patent drawings, oath, power of attorney, petition, filing fee and assignment (if any) constitute the patent application. These are the papers that the attorney or agent files in the Patent Office.

What Happens Next?

When the application papers are received in the Patent Office, they are given a quick check to see whether there are any omissions or errors which would render the application incomplete or seriously defective. If the form of the application appears to be satisfactory, the application is given a serial number and a filing date, which is the date the application was received in the Patent Office.

The serial number and filing date of the application are important to the inventor. In discussing the invention with other persons, the inventor may not wish to disclose the number and date of his application. Unless one is certain that he is far ahead of all other workers in the field, it may be good strategy not to share with potential competitors any of the chronological data pertaining to one's own invention.

Each patent application is allocated for consideration by an examiner, who is likely to be a specialist in the field to which the invention belongs. The examiner takes up each application in turn and makes a search to determine whether the application discloses and claims new and patentable subject matter.

He then prepares an "office action" indicating either the allowability or rejection of each claim in the application, and he mails the office action to the applicant's attorney.

Claims may be rejected or "objected to" upon the grounds of substance or of form; and the inventor should not necessarily be discouraged if the first office action is a rejection of all claims. The inventor should remember that he is asking that he be given a temporary monopoly of certain subject matter, and the examiner's duty in representing the people of the United States is to insure that any such monopoly granted to the inventor does not exceed that to which he is entitled by virtue of the invention he has disclosed.

Were You Anticipated?

As part of his office action, the examiner is likely to refer to or "cite" various patents or publications which he feels may "anticipate" the applicant's invention.

The applicant's attorney then studies these references and has six months within which to submit to the Patent Office an amendment in which the attorney makes any changes in the application that he feels may be necessary. He also submits reasons why he believes the applicant's claims in their amended form should be allowable as distinguished from the references cited by the examiner.

Ordinarily, the applicant and his attorney decide to continue the prosecution even though the scope of patent coverage obtainable may be less than they originally thought. In some cases they may even find that the prior art cited by the examiner is not as close to the invention as they anticipated it might be, whereupon the scope of some of the claims in the application may be broadened by amendment.

There are several office actions and several amendments of an application before the application reaches either allowance or a so-called "final rejection." In the event of a final rejection by the examiner, an appeal may be taken to the Board of Appeals, a Patent Office tribunal. If the Board of Appeals refuses to allow the claims in issue, the matter may be litigated further in the Court of Customs and Patent Appeals or in the U. S. District Court, Washington, D. C.

Very often, after a final rejection, the need for an appeal may be avoided by means of a personal talk or "interview," between the examiner and the applicant's attorney. In this interview they may be able to eliminate any remaining misunderstandings and agree upon the allowance of claims adequate to protect the invention.

Upon allowance of the application, the Patent Office sends out a notice of allowance which specifies the number of claims allowed in the application. Then the applicant has six months within which to pay a final fee, whereupon the application is "passed to issue" ready for printing of the formal document.

The patent document issues a few weeks after payment of the final fee, and is sent to the applicant's attorney. Not until the patent actually issues does the owner of the patent have the right to begin excluding others from making, using and selling the invention.

When the Patent Office has issued a U. S. patent it loses all further control over that particular patent; and of course, it does not enforce the patent for the benefit of the patentee. Although it may be later shown that the patent is for some reason invalid, the Patent Office cannot recall the patent or force the patentee to return it.

However, if the patentee should later find that his patent is invalid or inadequate for some reason which can be corrected, he may offer to return the patent and file for a "reissue patent."

4. What Are They Worth?

HOW TO TURN PATENTS INTO PROFITS

Patents are intended primarily to promote the progress of science and the useful arts. In so doing, patents serve the public by stimulating the introduction of new products and by leading to the establishment of new industries that employ many persons.

Without the assurance of some degree of protection of their investment, many individuals and corporations wouldn't dare to undertake the research and development programs or to buy the expensive capital equipment which the introduction of new products entails.

Although the benefit to inventors is intended to be secondary to the public benefit derived from the patent system, it's hardly necessary to point out that patents do benefit inventors through the monetary returns which sometimes accrue to successful inventors and through the public recognition accorded to those who contribute substantially to improvement of our material well-being.

However, it is only fair to point out that the commercialization of patents is often very difficult and that it's only a rare patent which enables its owner to retire and to occupy himself solely with the endorsement of royalty checks. In fact, unless the technical, economic and legal considerations relating to an invention are all carefully and competently handled, the net income resulting from the invention is likely to be negative.

Licensing of Patents

Although different persons and organizations take out patents for different reasons, it's usually the best policy to solicit patents only in cases where strong and reasonably broad protection appears to be obtainable, or where the commercial potentialities appear to be great. Patents should be exploited vigorously either by manufacturing under them or by securing licensees or purchasers for them.

Sometimes it's possible to secure patents on a group of related inventions, thereby endowing the owner of the patents with a very powerful bargaining tool. In fact, one of the most important reasons for taking out patents is for the purpose of using them as trading stock.

Thus, competitors in a given field often enter into cross-licensing arrangements with each other. Each manufacturer agrees not to enforce certain ones of his patents against the other. Although such an arrangement may mean that neither manufacturer derives royalties from the other, it may obviously mean that neither manufacturer is obliged to pay royalties to the other.

If the manufacturers are direct competitors they will usually be wise to grant one another licenses which are nonexclusive in nature. This will tend to free them from any accusation of conspiring to monopolize any line of commerce. Each manufacturer, by granting to his competitor a nonexclusive license, would reserve to himself the right to grant other licenses under the same patents. Moreover, to protect himself from an accusation of violating the antitrust laws, he might be wise to make a definite effort to find other licensees for those patents.

If one owns a patent which is outside the scope of his manufacturing business, he may feel relatively free to grant an exclusive license at a substandard royalty, or even to refrain from licensing it at all.

Alternatively, he may grant a paid-up license in exchange for a substantial lump-sum payment, thereby assuring himself that the licensee really intends to make use of the rights under the patent. On the other hand, a manufacturer might be glad to grant an exclusive license for a moderate sum to a

customer or a supplier if it would help his own business.

Assigning Inventions

An assignment of a patent is a conveyance by the patent owner to another of all rights in the patent which the patent owner possesses, including the right to enforce the patent against infringers.

A license under a patent is essentially an agreement by the patent owner not to sue the licensee for infringement, so long as the licensee's actions are within the terms of the agreement. Ordinarily a licensee doesn't himself acquire the right to enforce the patent against other persons, although the agreement may give the licensee the right to have the licensor (the patent owner) enforce it.

One common occasion for assignment of inventions and of patents granted thereon is the case of employees who make such inventions during the course of their employment. If an employee is hired especially to do research and development work and to make inventions, the employer is generally entitled to receive an assignment of any such inventions by the employee.

Inventions by other employees are likely to be their own unless they have agreed to assign their inventions to the employer.

However, if an employee used the facilities, materials or time of his employer to make his invention, the employer is entitled to a "shop right." A shop right permits the employer to practice the invention in his own place of business and for his own benefit. The justification is that an employer who makes his information and facilities available to an employee should have at least part of the benefit of inventions made with such assistance.

HOW TO ENFORCE AND PROTECT YOUR PATENTS

Inasmuch as the United States Government takes no action to enforce the patents which it issues, the burden of enforcement falls upon the owner of each patent.

Of course, a patent owner is perfectly at liberty to let his rights go by default. However, if he believes he may ever want to enforce his patent rights, he should do nothing which might lead others to believe that he has abandoned his rights.

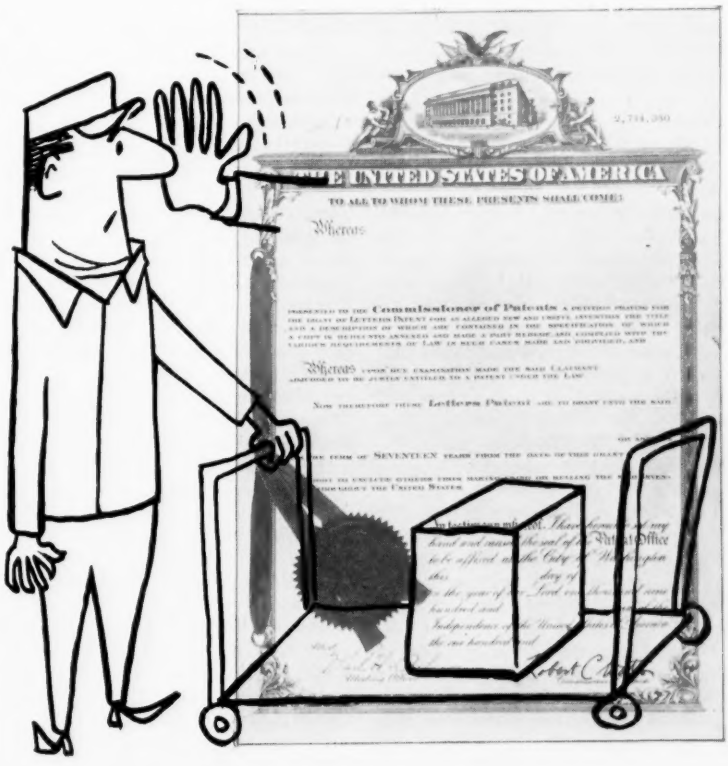
Assuming that a patent owner desires to enforce his right to exclude others from making, using and selling his invention, there are a number of things which he should do. First, if he is manufacturing a product covered by the patent, he should give notice that the product is patented by marking the patent number upon each such item manufactured and sold. Second, he should be vigilant to detect infringement of his patent by competitors and others.

If the patent owner is convinced that his patent is being infringed, he may give written notice to the infringer demanding that the infringement cease. Alternatively, he may wish to bring suit immediately in a Federal district court asking that the infringer be enjoined from committing further acts of infringement and be ordered to pay damages for past infringement.

Whether the litigation reaches the trial stage or not, there are two fundamental issues upon which the outcome is likely to depend. The first issue is whether or not the patent is valid; the second is whether or not the patent is infringed. Depending upon the answers to these questions—or what the parties believe the answers will be—there are a number of possible outcomes of the litigation. These are, for example:

- The infringer is enjoined from further acts of infringement and is ordered by the court to pay damages for past infringement, for a period of up to six years of past infringement.
- The alleged infringer takes—and pays for—a license under the patent.
- The alleged infringer shows that he is in fact not infringing the patent.
- The patent is shown to be invalid.

In summarizing this section on the value and enforcement of patents, it's sufficient to point out that patents are assets only if they are used. You seldom make any money by depositing your patent in a safe and forgetting about it.



5. The Search and Investigation

There are at least five important occasions when some kind of patent search or investigation is appropriate. They are:

- Before filing a patent application.
- Before entering a new field of research.
- Before commencing manufacture of a new product.
- Before taking a license under someone else's patent.
- Before patent litigation.

The purpose of the search is to gather information that will serve as the basis for a decision of some kind. The decision to be made in each case determines the type of search that may be called for.

Before You Apply

You make a search before filing a patent application to gather information tending to show whether the subject of the proposed patent application is or is not new. This search is often called a "preliminary search" or "novelty search" and is usually limited to a reasonably cursory examination of the classes of patents and literature which are most likely to contain disclosures of the subject matter in question.

Searching may be facilitated by taking advantage of the U. S. Patent Office *Manual of Classification*, which divides all patented subject matter into several hundred numbered classes. Each of the classes is divided into subclasses, according to a system intended to aid in the location of patents relating to a total of many thousands of specific subjects. Each patent issued within recent years bears beneath its title a notation of the class and subclass to which it belongs, e.g. 75-95, which refers to Class 75-Metallurgy; Subclass 95-Reactive furnace linings.

However, you should remember that the classification system is being revised continuously to accommodate new developments in technology. The classification notation that appears on a patent indicates only the class and subclass to which the patent belonged at the time of its issue. If, after its issue, a patent should be reclassified, the up-to-date classification can be obtained by referring to a card catalog in the Patent Office.

Usually the most satisfactory place in which to carry out a novelty search is the Public Search Room of the Patent Office, where copies of most of the issued patents are maintained in stacks classified according to class and subclass.

Let's assume that a device created by Inventor A is being evaluated by means of a novelty search. If a disclosure of the device being evaluated is found in any issued U. S. patent reference, the device cannot itself be patented by Inventor A unless he invented it in the United States before the filing date of the application on which the patent was issued. If a disclosure of the device being evaluated is found in any published material other than a U. S. patent, the device cannot itself be patented by Inventor A unless it was invented by A before the publication of the material.

If a disclosure of the device being evaluated is found in any public patent or published material more than one year old, the device should not be made the subject of a patent application because the device will not under any circumstances be validly patentable.

In many instances you may feel —justifiably so—that a novelty search is not necessary or desirable before filing a patent application upon a certain invention. This may be true if, for instance, the inventor is intimately familiar with substantially all that has been done in the field to which the invention pertains, or if the field to which the invention pertains is developing so rapidly that new improvements wouldn't yet be likely to have been described in issued patents or printed publications.

When a novelty search on an invention has been completed, the inventor and his attorney are in a good position to decide whether a patent application should be filed upon the invention. If patentability of the invention should be barred by one of the "statutory bars," it's clear that no application should be filed. On the other hand, if the invention seems to be new, useful and nonobvious, the inventor and his attorney may decide that the expense of filing and prosecuting a patent application will be justifiable; that the patent can be expected to make a profit.

On Entering a New Field

Fundamental reason for the existence of our patent system is the stimulation of the disclosure of new inventions to the public.

Inasmuch as millions of issued patents constitute a great store of technical information, it makes sense to use them as a source of background material upon entry into a new field of technical research. One way to get the pertinent background material is to make a "collection search" or "state-of-the-art search" through all the patents relating to the subject in which you are interested. Another way is to refer to the *Manual of Classification* and simply order from the Patent Office copies of all patents belonging to the subclasses which appear to be most pertinent.

The Patent Office will supply a list of all patents classified in any subclass. This lets you know in advance the expense which would be involved in such an order.

Before Making New Products

Before entering upon the manufacture of a new product, it's good practice to make, or have made for you, an "infringement" or "right-to-use" search through the unexpired U. S. patents. Purpose of such a search is to locate any patents that have claims which might be infringed if the contemplated manufacture were undertaken.

Although the field of an infringement search may be smaller than that of a novelty search, the infringement search is likely to be more expensive because of the care that is required in analyzing the patent claims to locate any which might be infringed. In analyzing patent claims, one must remember that the elements of a patent claim may be entitled to a range of equivalents which may depend on whether or not the invention is a basic one in its field.

If one or more patents discovered in the infringement search ap-

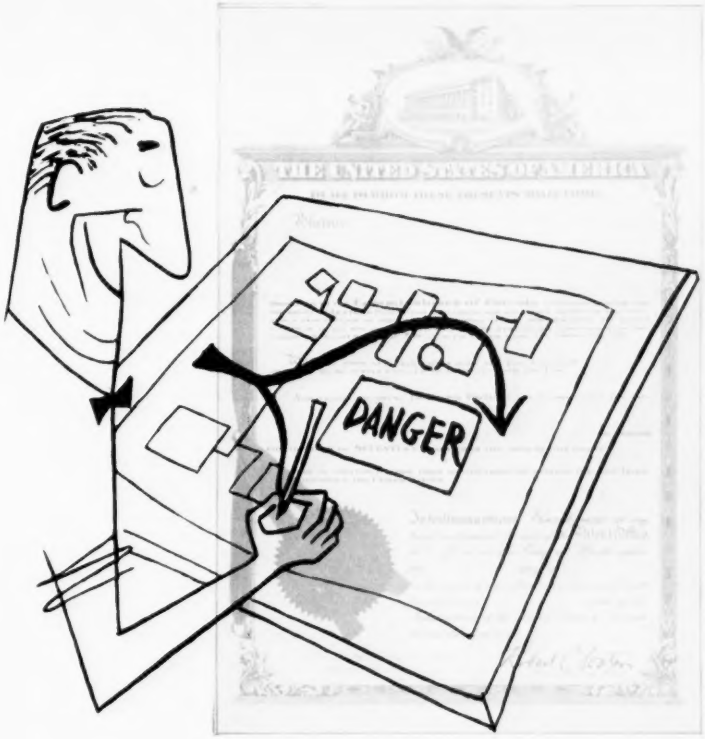
pears to have a claim which reads on the device or material proposed to be manufactured, there are a number of courses of action which remain open. Perhaps the first thing to do is to try to appraise the validity of the patent which it appears would be infringed by the proposed manufacture.

Assuming that the appraisal indicates that the troublesome patent is probably valid, the next course of action is to investigate whether the proposed manufacture might not be altered slightly so that the adversely held patent would not be infringed.

Of course, many factors, such as the specifications to be satisfied by the product and the magnitude of the investment already made in production facilities, will help determine whether it's feasible to design around the troublesome patent.

However, if an attempt is made to design around an adversely held patent by interchanging or substituting elements, the designer should bear in mind that a trivial change in the product may not be sufficient to avoid an infringement action.

Even a brief discussion of patent infringement would be inadequate without some mention of the topic on "contributory infringement." This consists in making and supplying a component of a patented combination, knowing that the component is especially suited for use in the patented combination. While one who makes and sells a staple article of commerce for use in a patented combination is not a contributory infringer of the patent on the combination, one who makes and sells a component especially designed and adapted for use in the patented combination is a contributory infringer of the combination patent.



Before License or Litigation

A manufacturer who finds that it is not practicable to change his product or process to avoid infringement of an adversely held patent may not be obliged to cease making the product or using the process. If he finds that the owner of the patent is willing to grant a license at a reasonable royalty, the manufacturer may be willing to take the license and pay the royalty.

However, before he negotiates for the license, he will in all probability have a "validity search" made in order to ascertain whether the patent is valid. A validity search is a comprehensive investigation of all possible factors which might render the patent invalid. Such factors include the statutory bars and also any technical defenses to the patent which might be available.

A technical defense would be available if, for example, the patentee had obtained coverage of substantially the same invention in an earlier patent. In that event, there would be a case of "double patenting" of the invention, and the second patent would be invalid. The defense of double patenting is based on the principle that only one 17-year period of monopoly should be granted on any single invention.

Before taking a license under a patent, one should determine whether the patent has ever been involved in litigation. If it has, find out whether there have ever been any adjudications adverse to the validity of the patent. If there have been any, the record of litigation should be studied as a source of information about the strength of the patent.

As soon as one is made a defendant in a patent-infringement suit, he is likely to undertake a validity search even more exhaustive than that which would be undertaken before negotiating a patent license.

Where you may be willing to pay a small royalty in order to have a license under a patent of questionable validity, you'd be likely to make an all-out effort to show invalidity of the patent that is asserted against you in an infringement suit. Not only does the defendant try to show that the patent asserted against him is invalid, but also that he does not actually infringe any of the claims of the patent.

The defendant may be able to show that, if the patent claims were construed broadly to read upon his product or process, the claims would also read on the prior art, and would be invalid.

Still another phase of the investigation which should be made before patent litigation is an investigation of title or ownership of the patent. If the defendant could show that the plaintiff did not have title to the patent or a right to sue thereon, the defendant would have a good defense to the infringement action.

6. How to Safeguard Secrets

Subject matter which has been patented may, of course, be protected by means of remedies afforded by the patent law; but subject matter which has not been patented presents special difficulties.

Guard Application Data

While the filing date of a patent application serves to prove that the subject matter contained in the application was conceived prior to the filing date and "constructively reduced to practice" on the filing date, you should remember that a pending patent application does not give the inventor any right to exclude others from making, using or selling his invention. Therefore, if an inventor wants to prevent others from benefiting from his invention during the period of pendency of the application, he must keep the invention secret until the patent is issued.

There are a number of other important considerations which pertain to the protection of material contained in pending patent applications. They are:

- While licenses are often issued under pending applications, the owner of an application may be wise to keep the filing date and serial number of the application secret during preliminary negotiations, revealing them only to prospective licensees who seem to have a *bona fide* interest.
- It's usually best to grant no free licenses. Later licensees may demand license terms identical with the most favorable terms which have been included in earlier licenses of the invention.
- All license agreements and other agreements pertaining to the invention should be in writing.
- The advice of the attorney on the matter of publication of the invention should be followed in order to insure that any desired foreign patent rights are not lost. Technical papers pertaining to the invention should be presented only after such rights are secured.
- It may be helpful to review each week's issue of the *Official Gazette of the United States Patent Office*. Here you can locate not only any new patents which might be infringed by the manufacture of the invention, but also any new patents which might have claims that would interfere with the claims in your application.

About Trade Secrets

There are many instances in which subject matter worthy of protection is not incorporated in patent applications. Such may be the case either because the subject matter is not patentable or because it is deliberately kept as a trade secret rather than being patented.

However, one who maintains a patentable invention in trade secrecy while using it for commercial purposes always runs the risk that, through changes of employees or otherwise, the secret will leak out and be irretrievably lost. While the courts may grant relief against persons who acquire such a secret by improper means, the courts will not enjoin from using the secret any person who learns it innocently.

Moreover, one who uses a process in secret until the secret leaks out may not only find himself barred from obtaining a patent, but under certain circumstances may find himself barred by a later patent from using his own process. Thus, it requires considerable judgment in order to determine whether the merits of patent protection outweigh the merits of secrecy in the case of some patentable subject.

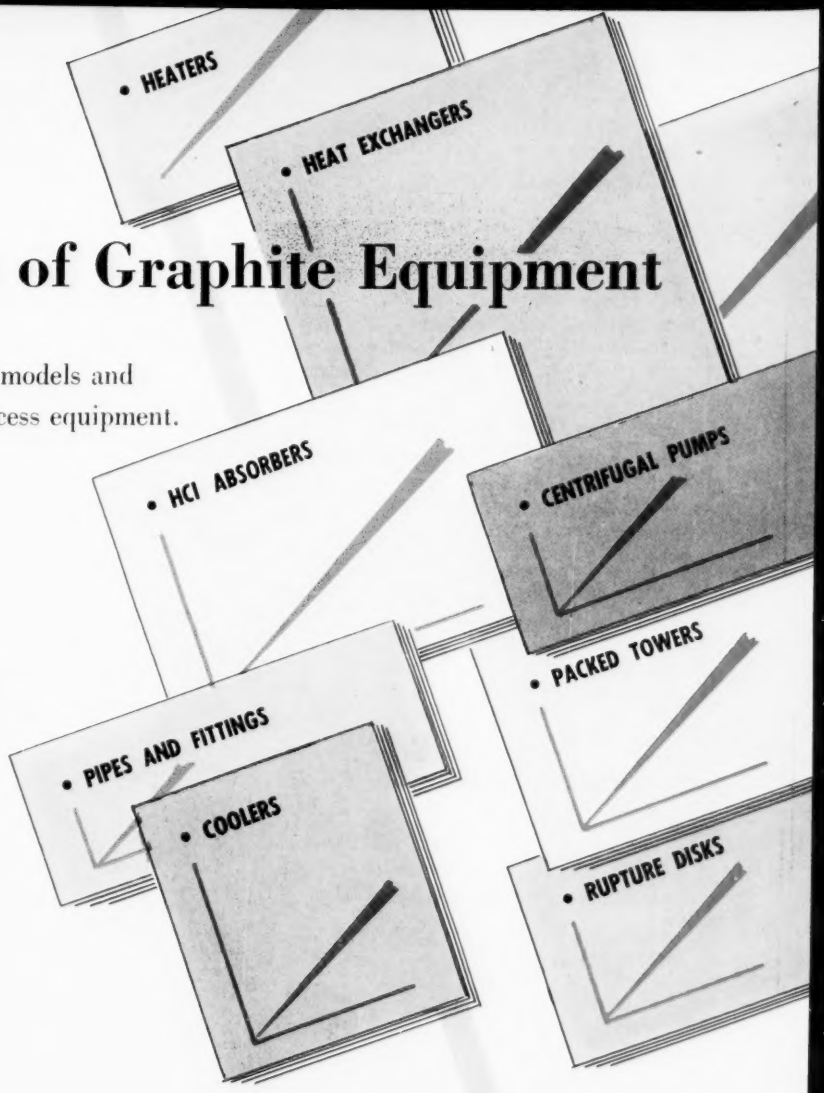
A matter which has been particularly troublesome to industrial companies is the matter of disclosures made to employees of the companies by persons outside the company. For a full problem of this intriguing problem, we recommend an article which appeared in *Chemical Week*, Aug. 17, 1957, p. 108.

Reprints Available

Reprints of this 16-page report will be offered for sale at 50¢ per copy. Watch for an announcement about availabilty in an early issue.

Estimate Cost of Graphite Equipment

Charts and tables give standard models and costs of impervious graphite process equipment.



JOHN REYS, Chief Engineer*
Falls Industries, Inc., Salon, Ohio

Due to an unusual combination of properties—impervious graphite, today stands on the threshold of widespread acceptance in processing equipment. In the short twenty years since the original development of this material, a growing awareness has sparked the demand for engineering cost data.

What's available in processing equipment and how much will it cost? These are the two questions the engineer has to consider when he's thinking about using impervious graphite. Here's the lowdown on what you can buy and how to estimate how much it will cost.

What's Special About It?

One of the most important properties of impervious graphite is its resistance to the effects of practically all corrosives except a few strong oxidizing agents. In addition, impervious graphite is immune to thermal shock, it's noncontaminating and it has a very high rate of thermal conductivity.

These properties make it unique as a material of construction. So unique, in fact, that impervious graphite equipment, taken on a long-range basis, can very often result in low-priced construction.

Over the years, design standardization and improved methods of fabrication have made it possible to offset the increased costs of raw materials and labor. We now find that strange contradiction in modern times where prices for impervious graphite equipment are no higher today than in 1938 when this material was developed.

*Meet your author on page 172.

There are now a great variety of standard designs available for use in a wide range of processing applications. An equally wide range of custom equipment is available from producers.

For each of the major types of standard impervious graphite processing equipment, we'll present charts that can be used to make cost estimates. Costs shown in the charts are based on figures for Jan. 1957. There may be some variation between estimated costs and those quoted by a specific manufacturer. Nevertheless, the prices are accurate and are designed to be used in actual estimating work.

Tube and Shell Heat Exchangers

Impervious graphite tube and shell heat exchangers normally are composed of a bundle of ¾-in. I. D. graphite tubes with cast iron baffles, housed in a steel shell. Variations of this standard design include lining the shell to permit handling of a corrosive on the shell side, or the shell can be supplied in alloys, impervious graphite or other materials.

These exchangers can be used at operating temperatures to 340 F. and at hydrostatic pressures up to 75 psi. (50 psi. steam pressure).

Tube and shell exchangers are available in a great variety of standard increments of heat transfer surface.* A range exists from 7.5 sq. ft. of shell side transfer surface area to over 2,300 sq. ft. Standard heat transfer units are given a detailed breakdown in the

* All equipment models listed are standard designs manufactured by Falls Industries, Inc. While individual producers have standard carbon and graphite equipment other than those listed, cost estimates derived from this article will still remain accurate.

accompanying table. For the most economical selection, the next higher standard increment exchanger above the actual requirements should be chosen.

Cost ranges are shown in Figs. 1 through 5. Depending upon the modifications, there will be some variation in these cost ranges.

Cubical Type Heat Exchangers

When the problems of frailty and size connected with the tube and shell design arise, the cubical type exchanger is an answer.

Basically, the Cubical exchanger is a cube of impervious graphite that's been drilled to permit passage of two materials. Good resistance to internal and external physical shock is obtained by housing the cube in cast iron headers.

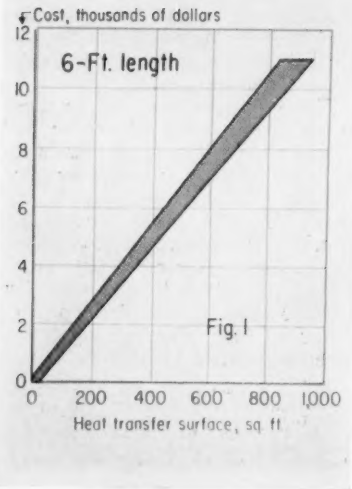
Cubical exchangers are suitable for heat transfer with liquids or gases, as well as for evaporation and condensation. Headers can be lined so that almost any corrosive can be accommodated on the shell side. Operating limits are 100 psi. at a temperature of 340 F.

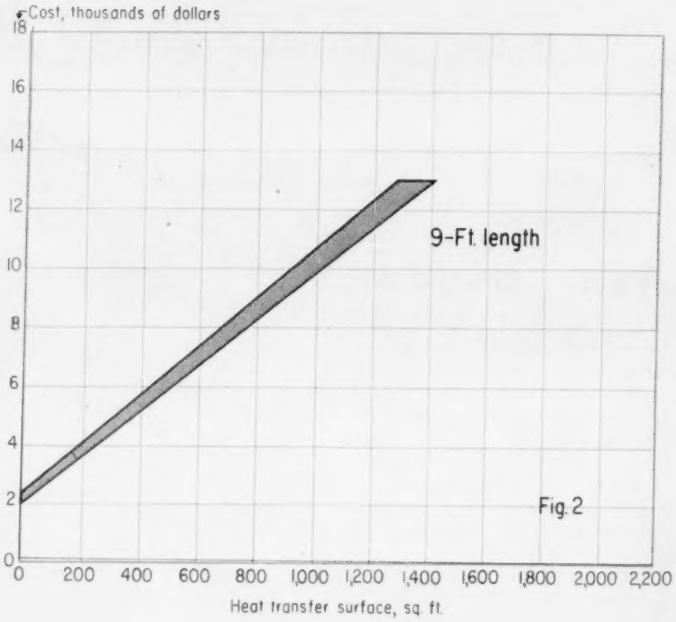
Sizes available and cost are listed below:

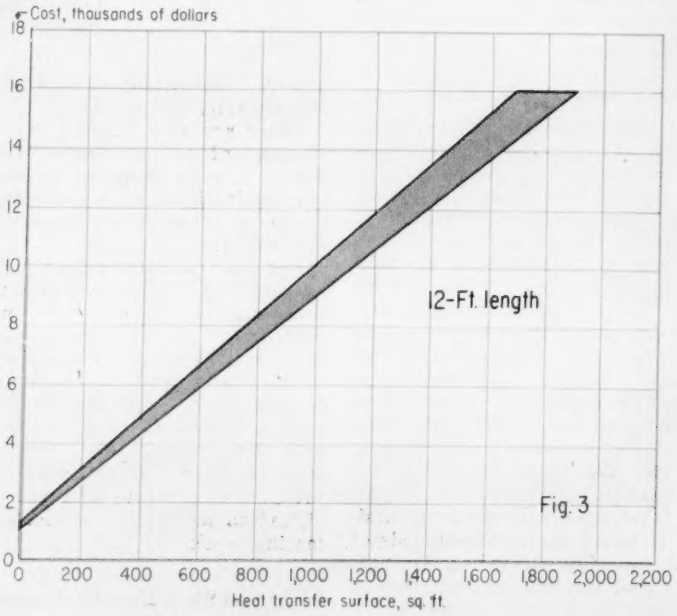
Transfer Area, Sq. Ft.	Cost, Dollars/Sq. Ft.
11	65
21	45
50	30
90	19

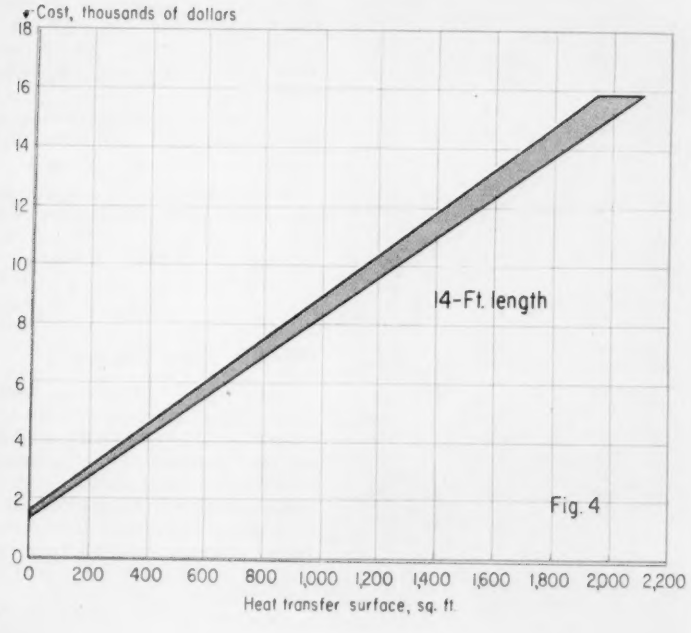
Although there are only four

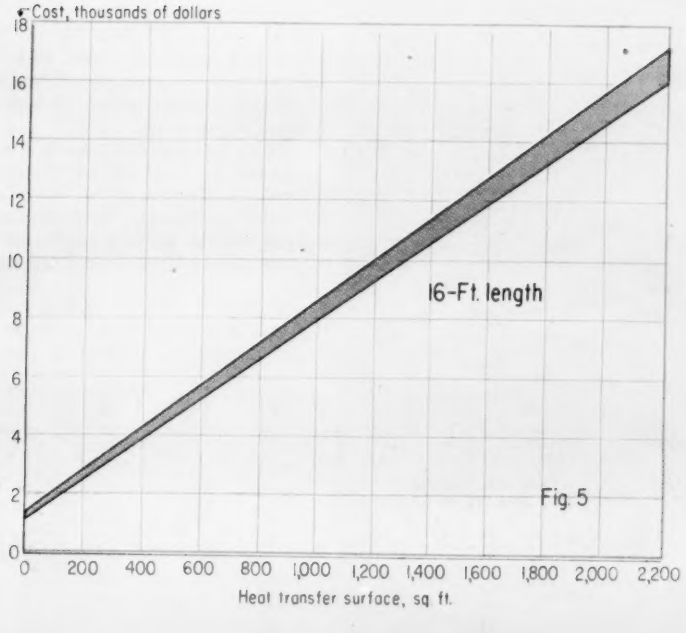
Estimate Costs for Tube and Shell Exchangers











standard sizes available, special interconnectors are available to permit assembly of more than one cubical unit without an excessive pressure drop.

Cross-Bore Heat Exchangers

Standard Cross-Bore exchangers are only available in impervious graphite. They have the same outside dimensions as a tube and shell design, but instead of a tube bundle, this exchanger makes use of a solid heat transfer cylinder that is cross-bored to obtain the required passages.

Certain advantages directly attributable to this design are:

- Accommodation of the highest operating pressures of any graphite exchanger—150 to 200 psi.
- High resistance to internal and external mechanical shock. In some instances it's being used to perform both heating and cooling functions.
- It permits simple removal of the heat transfer cylinder. This allows accessibility for cleaning the passages on both tube and shell sides.

Standard models available are shown in the table below Fig. 6. Values shown are for 9 ft. long units. For 12 ft. long cross-bore exchangers, it's necessary to add 33⅓% to the appropriate values.

Costs are shown in Fig. 6.

Plate Type Immersion Heaters

Plate heaters are designed for steam heating while immersed in direct contact with corrosive liquids in tanks.

Five models are available as standard. Four are designed for vertical mounting, one for horizontal. All vertical models can be had in standard lengths to 94 in.

These heaters have a use limit up to 50 psi. steam pressure at 340 F. and have heat transfer areas up to 105 sq. ft. Models available in terms of heat transfer area are: vertical—3.8, 7.0, 10.2 and 13.5 sq. ft./ft. of length; horizontal—3.8 sq. ft./ft. of length.

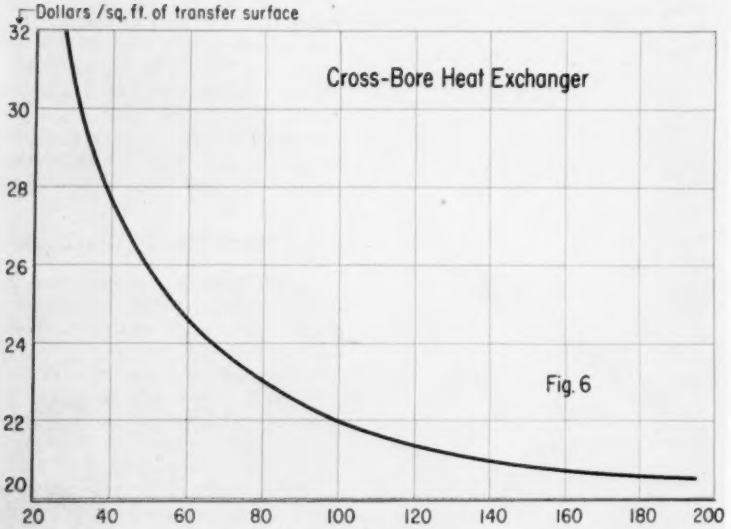
Representative costs/sq. ft. of transfer area are shown in Fig. 7.

Bayonet Heaters

Intended for pilot plant, laboratory and small batch operations,

Standard Model Tube and Shell Heat Exchangers

Shell Dia., In.	No. of Tubes	Shell Side Transfer Area, Sq. Ft., For Standard Tube Lengths				
		6 Ft.	9 Ft.	12 Ft.	14 Ft.	16 Ft.
6	7	16	24	32	....	....
8	14	28	42	56	64	73
10	24	48	72	96	110	126
10	31	64	96	128	141	162
12	31	64	96	128	141	162
14	42	82	123	164	192	220
14	38	74	112	148	174	199
16	64	125	188	250	292	335
16	55	108	162	216	252	288
18	85	166	250	332	388	445
18	74	145	218	290	339	387
20	109	214	320	427	500	570
20	92	180	270	360	420	481
22	130	255	383	510	595	680
22	121	236	356	472	554	634
24	163	320	480	640	745	850
24	151	296	444	592	690	790
26	197	386	580	772	900	1030
26	170	333	500	666	778	890
28	235	460	690	920	1070	1230
28	206	405	606	810	945	1075
30	268	525	790	1050	1230	1400
30	241	472	710	944	1100	1260
34	349	685	1025	1370	1600	1830
34	316	620	930	1240	1445	1650
38	439	860	1290	1720	2010	2300
38	403	802	1200	1600	1845	2140



Standard Model Cross-Bore Heat Exchangers

Shell Dia., in.	Tube-Side Transfer Area, Sq. Ft.	Shell-Side Transfer Area, Sq. Ft.
6	21.2	24.7
8	35.7	42
10	58	67
12	86.5	100
14	115	126
16	152	168
18	187.5	178.5

impervious graphite bayonet units are available with lengths up to 6 ft. and heat transfer surfaces to 6.3 sq. ft.

These exchangers can be mounted horizontally or vertically through an enclosed section of the vessel containing the material to be heated or cooled. They can also be suspended vertically through an open section.

Standard models available are given below with the costs shown in Fig. 8.

No.	Tube Size, In. I.D.	O.D.	Transfer Area, Sq. Ft./Ft. of Length
1	1.5	2	0.52
2	2	2.625	0.69
3	2.5	3	0.79
4	3	4	1.05

Cascade Type Coolers

Impervious graphite cascade type coolers are in extensive use where a large quantity of cheap water is available for cooling great volumes of corrosives. Good examples include the cooling of hydrochloric acid from the absorber before storage and the removal of the heat of solution during sulfuric acid dilution.

Cascade coolers consist of a vertical bank of impervious graphite tubes. These coolers can be joined in parallel or series to obtain practically any required amount of heat transfer surface. On top of this bank is located a distributor tray to which water is piped and then permitted to cascade down and over the tubes containing the material to be cooled.

This type of equipment has an operational limit of 340 F. at hydrostatic pressures to 75 psi. In certain instances, however, provisions can be made to increase the temperature limit to as high as 750 F.

Standard models available are given below while Fig. 9 graphs the cost/sq. ft. of cooling surface.

Length, Ft.	I.D., In.	Outside Transfer Area, Sq. Ft./Section,
9	1	3.53
9	1.5	4.71
9	2	6.48
9	3	9.43
9	4	12.37
18	1.5	9.42
18	2	12.96
18	3	18.86
18	4	24.74
27	1.5	14.13
27	2	19.44
27	3	28.29
27	4	37.11

Pipes and Fittings

Impervious graphite pipe provides a relatively fool-proof system for the transmission of corrosives. However, because of the unique nature of the material, a complete understanding of installation techniques should be obtained for better efficiency and economy of use.

All necessary fittings are available in impervious graphite, including flexible couplings, sight fittings, reducer bushings, collars for flange joints and required gaskets.

These pipes and fittings are also available in armor. Here, the pipe is protected against mechanical damage as well as high pressure explosions by a glass fiber reinforced sleeve. Fittings are armored in the same manner or with heavy-duty castings bolted in place around the fitting.

To show typical costs, a typical pipe run with a normal amount of fittings is shown below. These costs are for standard nonarmored pipe and fittings.

Pipe Size, In.	Cost/Ft., Dollars
1	3.87
1.5	4.73
2	6.55
3	13.50
4	19.70
6	38.00

Centrifugal Pumps

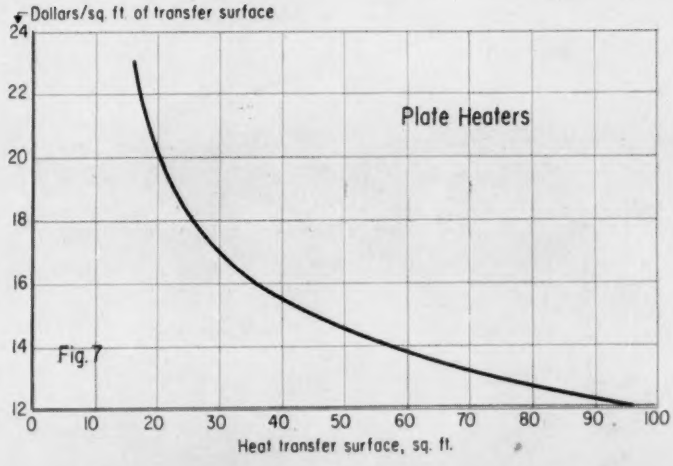
Single-stage centrifugal pumps are made from impervious graphite with two types of shaft seals: self-cooling, using the pumped liquid itself to help cool the seal; and a separately cooled sealing method where an external system is used with a special coolant.

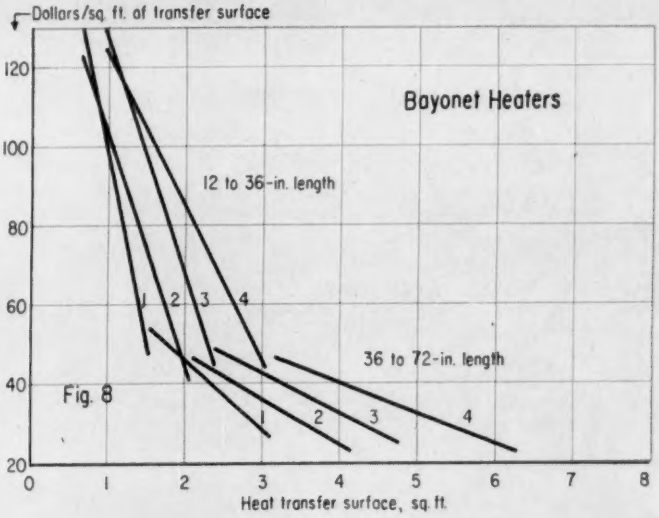
Given below, the table covers costs and a description of six sizes of impervious graphite pumps with a self-cooling seal.

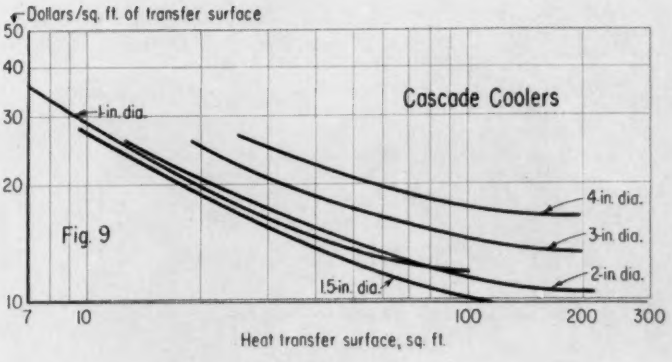
Motor Required, Hp.	Capacity, Gpm.	Head Pressure, Ft.	Cost, Dollars
0.75	25	20	475
1.5	50	20	525
3	50	55	700
5	200	55	750
7.5	100	100	780
15	200	100	825

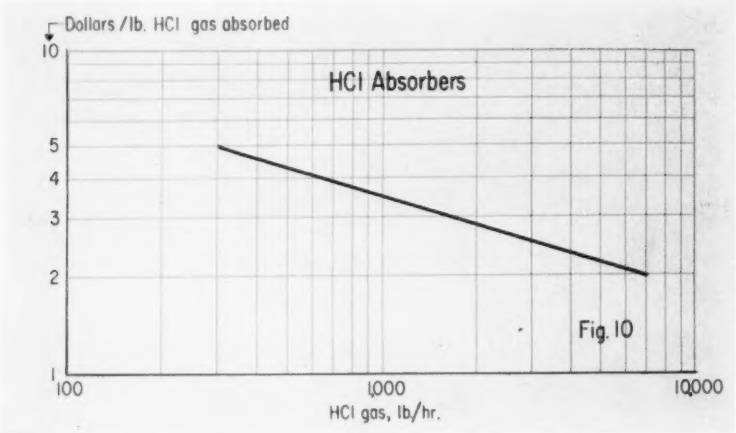
In all cases, all parts of the pump contacted by the corrosive are made of impervious graphite. Operating limit of these pumps is 75 psi. at 340 F. (*Continued*)

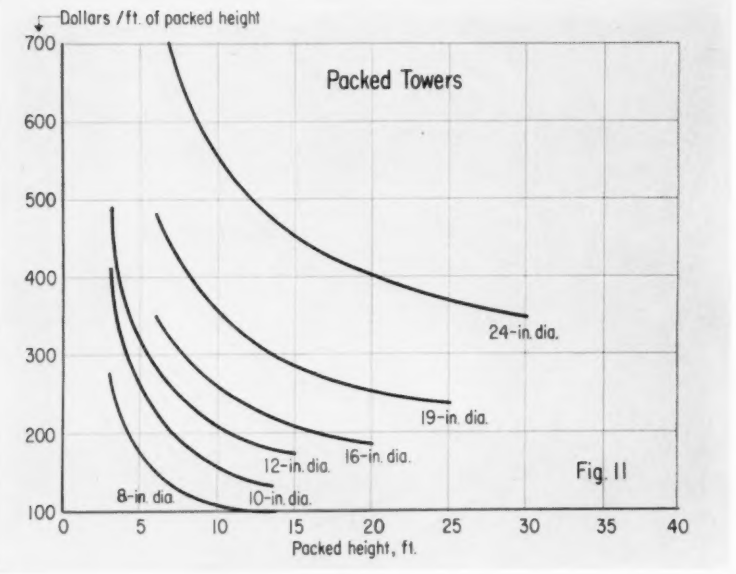
Estimate Costs for Heaters and Coolers

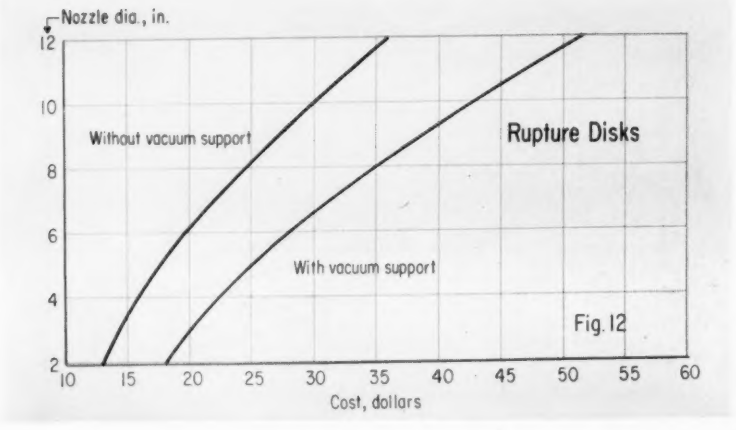












Hydrochloric Acid Absorbers

Falling film type impervious graphite absorbers are designed specifically for production of hydrochloric acid.

The absorber consists of a scrubbing tower mounted vertically above a tube and shell absorber. Sizes are available for production quantities of 500 lb./hr. to 10,000 lb./hr. Feed gas can range from 40 to 100% with water temperatures from 40 to 90 F.

In addition, complete HCl production plants can be obtained that make use of impervious graphite equipment throughout, including the piping, pumps, valves and coolers.

Based on the cost/lb. of desired production volume, Fig. 10 shows the cost of the absorber unit alone.

Packed Towers

Packed, jacketed and internally cooled towers are available in impervious graphite. These can be used for any suitable solvent-gas absorption requirement as well as for HCl production.

In terms of numbers produced, the packed tower is the most popular. It gives the best economy in regard to effective surface area.

Packed towers can be obtained in diameters up to 30 in. and with a maximum packed height of 40 ft. These towers will accept any standard packing.

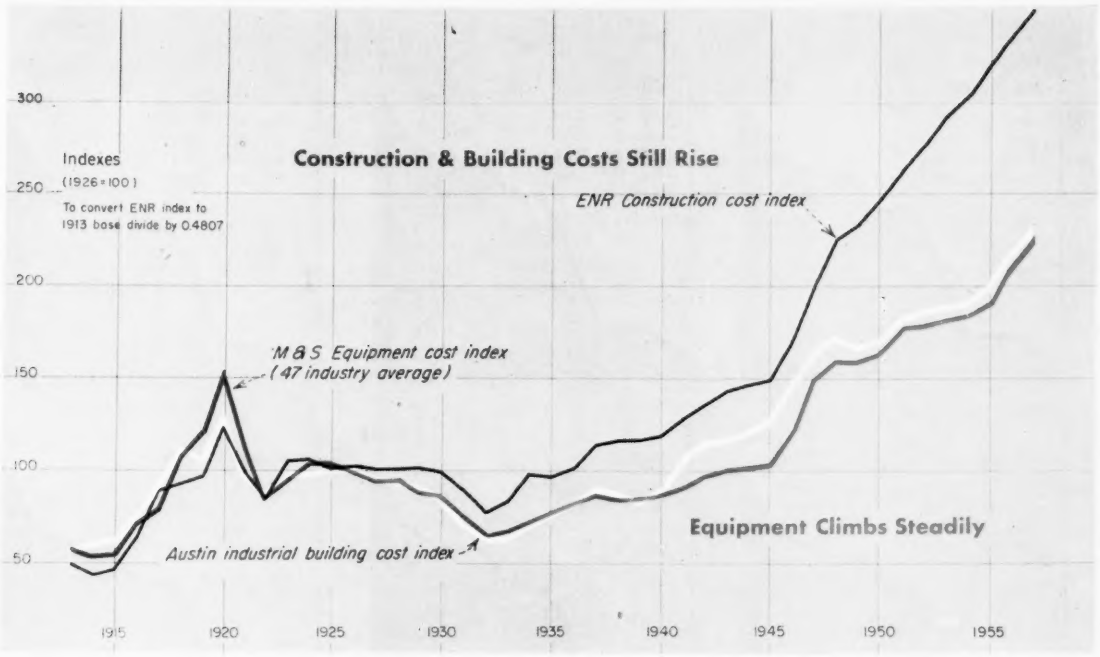
Good stability in operation is provided by the design, even with fluctuating gas rates. Where cooling water is at a premium or not required, this design can be used as an adiabatic unit.

Costs are shown in Fig. 11.

Rupture Disks

Rupture disks from impervious graphite is a new idea that makes use of the inherent properties of graphite to produce a striking advance in frangibles. Some of the major considerations of graphite rupture disks are: corrosion resistance; lack of variation in burst characteristics regardless of temperature; and no fatigue failure.

Sizes are available from 2 in. to 24 in. for service from full vacuum to 250 psi. These disks are made for standard mounting in ASA flanges. Costs are presented in graph form in Fig. 12.



Equipment Costs Continue Upward

Equipment costs for the CPI rose steadily during each quarter of 1957, again forcing yearly averages to new highs.

Charted above is a 47-industry average of equipment cost indexes prepared by the evaluation engineering firm of Marshall and Stevens, Incorporated of Illinois, Chicago 4. Basis for each of the individual indexes upon which the average is based, and the method of weighting the average, are described on pages 124-6 of our November 1947 issue, in an article by the late R. W. Stevens, partner of the firm.

Also plotted on the same grid are the Austin Co.'s index of industrial building costs, and the *Engineering News-Record* index of heavy construction costs.

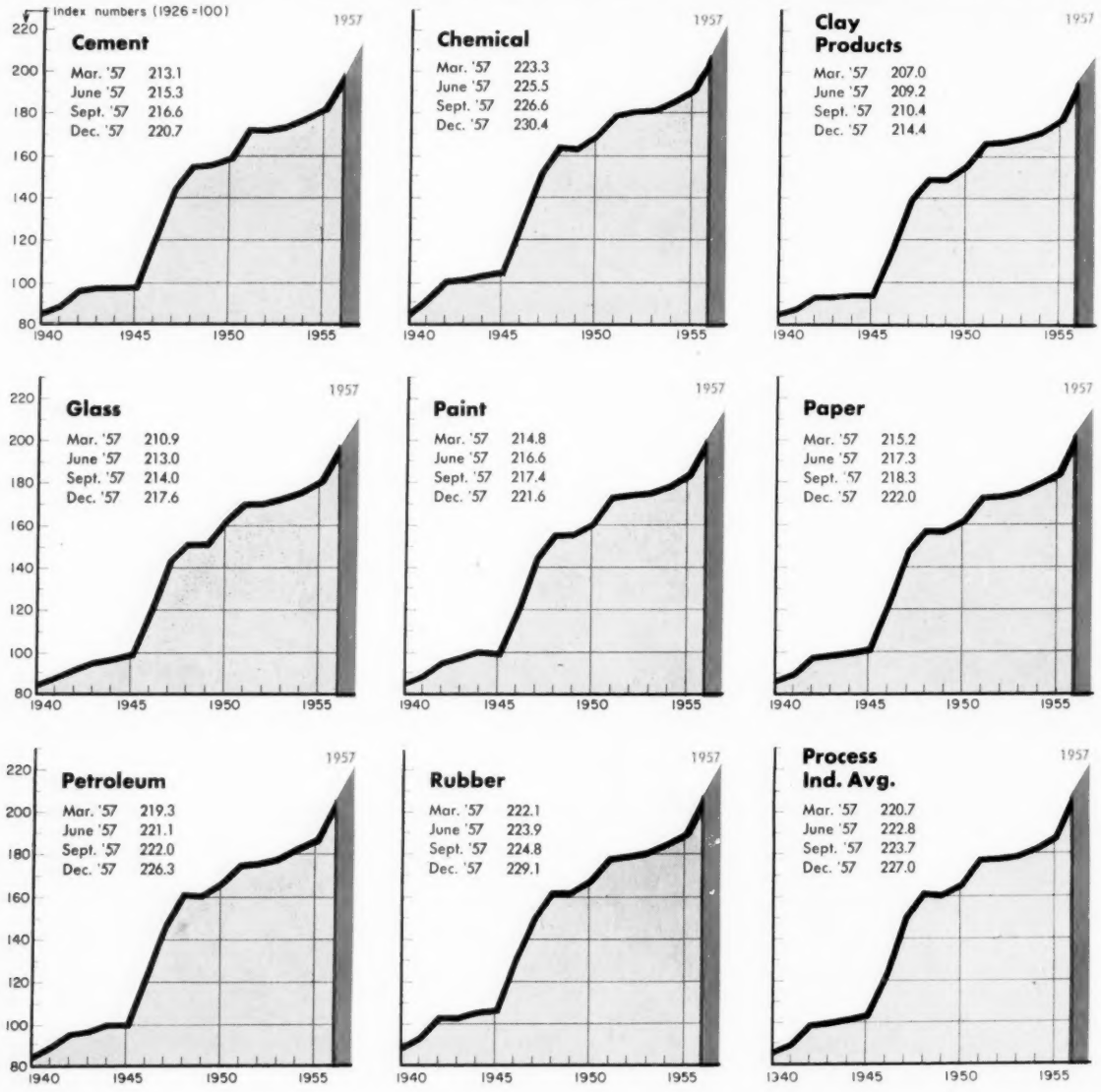
The M & S annual average indexes of comparative equipment cost for eight process industries and four related industries are chronologically tabulated below. Extending from 1913 through 1957, these averages are supplemented by quarterly figures on the individual charts on the next page.

A tabulation in the Process Equipment section of every issue during 1958 will show latest revisions for the quarters ending March, June, September and December.

Marshall and Stevens Annual Indexes of Comparative Equipment Costs, 1913 to 1957 (1926 = 100)

	1913	1916	1918	1920	1922	1924	1926	1928	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
Average of all	57.9	62.8	109.7	153.3	85.5	105.3	100.0	96.5	87.0	76.9	66.1	69.4	74.6	78.0	81.6	88.3	84.4	84.3
Process Industries																		
Cement mfg	58.0	62.5	109.1	149.2	83.7	104.6	100.0	97.2	87.0	76.8	68.9	70.7	75.7	78.1	82.2	88.8	85.2	84.2
Chemical	59.0	63.0	111.9	150.5	82.5	105.6	100.0	96.9	82.0	78.0	77.6	70.9	75.4	78.5	82.5	88.2	84.4	83.4
Clay products	60.7	65.3	120.0	154.3	82.9	105.7	100.0	97.0	86.1	78.0	70.6	71.1	75.7	79.3	83.2	87.8	83.2	82.3
Glass mfg	58.7	63.5	112.1	151.1	83.7	101.9	100.0	95.9	86.6	77.9	69.4	71.2	75.4	78.5	82.6	88.0	83.4	82.5
Paint mfg	58.2	62.8	108.0	148.5	84.1	104.0	100.0	94.6	85.7	76.6	67.0	69.2	74.3	77.0	80.4	87.4	83.9	83.4
Paper mfg	60.4	63.4	111.8	152.6	83.1	105.6	100.0	96.8	86.5	77.1	67.2	69.9	75.4	78.5	82.7	88.1	84.8	83.7
Petroleum ind	58.9	64.1	113.0	151.5	82.7	106.0	100.0	97.1	86.2	77.6	70.1	70.6	76.0	78.7	82.6	87.8	83.3	82.1
Rubber ind	58.6	63.8	113.8	154.2	88.0	105.9	100.0	91.9	86.2	77.0	67.1	70.7	75.2	78.1	82.2	88.4	85.4	84.9
Related Industries																		
Elec. power equip	59.1	64.3	114.2	152.2	83.6	106.0	100.0	96.9	86.1	78.1	70.1	70.7	75.5	78.7	82.7	87.9	84.3	83.7
Mining, milling	56.8	62.9	111.9	149.9	82.8	105.6	100.0	97.2	86.7	76.8	67.6	80.0	85.6	88.5	92.4	97.1	92.6	91.7
Refrigerating	59.3	63.2	113.5	153.5	83.9	96.1	100.0	97.0	86.4	75.0	70.0	71.3	75.4	78.9	83.0	87.5	83.0	81.8
Steam power	59.1	64.3	114.2	152.2	82.7	106.1	100.0	96.9	86.2	88.1	70.1	70.7	75.5	78.7	82.7	87.0	82.2	81.3

1957–Another year of growing equipment costs for all segments of CPI



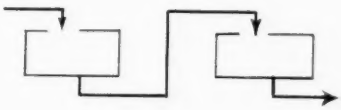
M & S Annual Indexes (continued)

	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Average of all	86.1	92.6	99.6	100.5	102.4	103.4	123.2	150.6	162.8	161.2	167.9	180.3	180.5	182.5	184.6	190.6	208.8	225.1
Process Industries																		
Cement mfg	85.1	90.8	97.8	98.3	98.6	99.4	119.7	144.3	156.5	156.5	161.6	172.7	172.8	174.6	177.6	182.6	199.4	216.4
Chemical	84.3	93.3	102.0	103.1	105.6	106.5	126.8	151.5	164.5	164.5	169.6	180.7	181.1	183.1	186.2	191.5	209.1	226.5
Clay products	83.4	87.6	93.1	93.6	93.9	94.8	115.0	139.8	151.5	151.5	156.6	167.7	167.8	169.5	172.4	177.3	193.8	210.2
Glass mfg	84.0	88.2	93.7	94.7	96.5	97.4	117.6	142.3	154.6	154.6	159.7	170.8	171.0	173.0	176.0	180.9	197.5	213.8
Paint mfg	84.6	90.3	97.3	98.3	100.1	101.0	121.2	145.9	157.8	157.8	162.9	174.0	174.4	176.3	179.3	184.3	201.2	217.6
Paper mfg	84.8	90.5	97.5	98.7	101.3	102.2	122.4	146.9	158.1	158.1	163.2	174.3	174.7	176.6	179.6	184.6	201.5	218.2
Petroleum ind	82.5	88.2	95.2	96.7	100.0	100.9	121.6	147.1	160.9	160.9	166.0	177.1	177.6	179.7	182.8	188.0	205.4	222.2
Rubber ind	86.0	94.2	102.7	103.7	105.5	106.4	126.6	151.2	163.3	163.3	168.4	179.5	180.0	182.1	185.2	190.5	207.9	224.9
Related Industries																		
Elec. power equip	85.3	90.5	96.5	97.5	99.3	100.2	122.9	150.0	166.1	166.1	171.2	182.3	182.8	185.0	188.0	193.3	211.0	229.2
Mining, milling	92.8	98.5	105.5	106.2	107.3	108.2	128.4	152.9	165.2	165.2	170.7	181.4	181.9	184.1	187.1	192.6	210.4	227.9
Refrigerating	82.7	89.0	95.8	97.0	100.2	101.7	125.7	163.2	176.6	175.8	185.2	200.1	200.7	202.8	204.8	211.6	234.3	254.2
Steam power	82.4	86.6	92.1	92.8	93.9	94.8	116.0	141.7	153.2	153.2	158.4	169.9	170.5	172.6	175.5	180.4	197.0	213.0

Two first-order systems. . .

y_i: Initial concentration, heat or other dependent variable

Initial conditions such as P. & T. remain constant



y_f: Final concentration, heat or other dependent variable

Yield a second-order linear differential equation.

$$a_0 \frac{d^2y}{dx^2} + a_1 \frac{dy}{dx} + a_2 y = F(x)$$

When Coefficients Are Constant

Solve Second-Order Linear Equations

Applied problems show how to analyze second-order equation to determine system performance. Use of symbolic operator simplifies mathematical manipulations.

WILLIAM E. BALL, Washington University, St. Louis, Mo.
R. CURTIS JOHNSON, Compumatix, Inc., St. Louis, Mo.*

We complete the mathematics refresher by examining the form and solutions of the second order linear differential equation with constant coefficients. We also show the importance of this equation in mathematical analysis.

Let us consider a simple tank problem to show the origin of such an equation. At the same time we'll introduce certain simplifying nomenclature.

Problem 1—Two tanks in series have volumes of V_A and V_B respectively. The concentrations of the salt solutions are C_A and C_B. Initially, C_A equals C_B. At time zero, solution of concentration C_i is fed at the rate of R cfm. to tank A. Flow from tank A to tank B is R cfm. and exit flow from tank B is also R cfm.

Assume concentrations of the exit streams are the same as the solution concentrations within the tanks. Derive the differential equations.

Solution—Write equations to show salt balance. Salt balance on tank A:

$$(RC_i - RC_A)\,d\theta = d(V_A C_A) = V_A\,dC_A \qquad (1)$$

$$V_A\,dC_A/R\,d\theta + C_A = C_i \qquad (2)$$

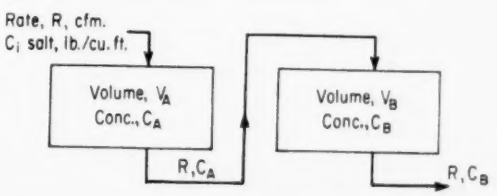
Salt balance on tank B:

$$V_B\,dC_B/R\,d\theta + C_B = C_A \qquad (3)$$

To simplify our writing, define $V/R = \tau$ and rewrite Eqs. (2) and (3).

$$\tau_A\,dC_A/d\theta + C_A = C_i \qquad (4)$$

$$\tau_B\,dC_B/d\theta + C_B = C_A \qquad (5)$$



To solve the equations, we begin by solving Eq. (4) which yields an equation relating C_A to θ. Using this relation for C_A in Eq. (5), we solve for C_B as a function of θ. This approach is straightforward but it can be laborious. It may also require solving for quantities whose values need not be known. We may eliminate C_A from Eq. (5) to yield

* Meet your authors on p. 172-173.

a differential equation with C_B as the only dependent variable. This solution yields C_B as a function of θ without solving for C_A. Differentiating Eq. (5):

$$\tau_B \frac{d^2C_B}{d\theta^2} + \frac{dC_B}{d\theta} = \frac{dC_A}{d\theta} \quad (6)$$

We now substitute C_A from Eq. (5) into Eq. (4) and $dC_A/d\theta$ from Eq. (4) into Eq. (6).

$$\tau_B \frac{d^2C_B}{d\theta^2} + \frac{dC_B}{d\theta} = \frac{C_i}{\tau_A} - \frac{\tau_B}{\tau_A}\frac{dC_B}{d\theta} - \frac{C_B}{\tau_A}$$

$$\tau_A\tau_B \frac{d^2C_B}{d\theta^2} + (\tau_A + \tau_B)\frac{dC_B}{d\theta} + C_B = C_i \quad (7)$$

These equation containing higher order derivatives become rather clumsy to write. We might seek a simpler method of expressing them.

Suppose we rewrite Eqs. (4), (5) and (7) as follows:

$$(\tau_A \frac{d}{d\theta} + 1)C_A = C_i \quad (8)$$

$$(\tau_B \frac{d}{d\theta} + 1)C_B = C_A \quad (9)$$

$$[\tau_A\tau_B \frac{d}{d\theta}\frac{d}{d\theta} + (\tau_A + \tau_B)\frac{d}{d\theta} + 1]C_B = C_i \quad (10)$$

Here the term $(d/d\theta)C_A$ means $dC_A/d\theta$. Similarly $d/d\theta[\,(d/d\theta)\,]C_B$ means $d^2C_B/d\theta^2$. Terms such as $d/d\theta$ are called operators since they signify that an operation is to be performed. In this sense, all of our symbols such as $+$, $-$, $\times$ and $\surd$ are operators because they instruct us to perform some operation.

Use of the operator $d/d\theta$ does not save much time. We simplify our writing further by letting the symbol D means $d/d\theta$. Then our equations become

$$(\tau_A D + 1)C_A = C_i \quad (11)$$

$$(\tau_B D + 1)C_B = C_A \quad (12)$$

$$[\tau_A\tau_B D^2 + (\tau_A + \tau_B)D + 1]C_B = C_i \quad (13)$$

where we assume that $d/d\theta$ $(d/d\theta)$ which is equivalent to $d^2/d\theta^2$ may be written as D.[2] We have no justification for this now.

The operator notation offers several distinct advantages. It simplifies the writing of equations. It also simplifies derivation as we shall see later. Under certain restricted but important cases, operators may be handled as algebraic quantities. We'll discuss this later. Finally there is a close relationship between this operational form and others which are in use in control systems calculations.

New Refresher Series Begins March 24

Mass Transfer Operations

By J. O. Osburn

- Calculations for equipment design and operation using mass transfer coefficients.
- Newer concepts of theoretical contacts, equilibrium stages and transfer units as applied to equipment design.

To see how derivation is simplified, let's start with the operational forms:

$$(\tau_A D + 1)C_A = C_i \quad (14)$$

$$(\tau_B D + 1)C_B = C_A \quad (15)$$

First solve for C_A from Eq. (14) which gives $C_A = C_i/(\tau_A D + 1)$. Now substitute this expression into Eq. (15) to get:

$$(\tau_B D + 1)C_B = C_i/(\tau_A D + 1). \quad (16)$$

$$[\tau_A\tau_B D^2 + (\tau_A + \tau_B)D + 1]C_B = C_i \quad (17)$$

This equation is a typical second order ordinary differential equation with constant coefficients. Many different physical and chemical systems yield this type of equation. For the moment let us consider the various forms of the solution to this second order equation.

How to Solve the General Equation

Let us write a general form for the second order equation.

$$a_0y'' + a_1y' + a_2y = F(x)$$

Using the operator notation, we write the above as:

$$(a_0D^2 + a_1D + a_2)y = F(x)$$

The above equation says that some function of x, known only as y for the moment, is of such a form that a linear combination of the function, its first derivative and its second derivative is equal to some known function $F(x)$. The complete equation is as given. Here $F(x)$ is called the forcing function. When we set $F(x)$ equal to zero, the remaining equation is called the reduced equation.

There are two entirely different sets of solutions to the complete solution. The reduced equation of Nth order yields N linearly independent functions. A linear combination of these functions is called the complementary solution. Thus, the second order equation yields two functions which form the complementary solution.

The solution of the complete equation is known as the particular solution. This does not contain any terms that are found in the complementary solution. The sum of the complementary and particular solutions gives the general solution of the unreduced or complete equation.

Example Illustrates Definitions

In the complete equation $2y'' + 7y' + 3y = x$, the forcing function is x. The reduced equation is $2y'' + 7y' + 3y = 0$.

To find the complementary solution, write the reduced equation in operational form $(2D^2 + 7D + 3)y = 0$. Factor this equation and solve for values of D. Each value of the operator D corresponds to a solution of the general form $y = Ce^{rx}$ where C is an arbitrary constant and r is a value of D.

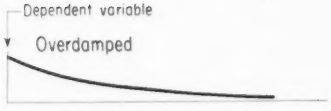
Hence the required solution is the sum of the individual solutions.

$$y = C_1e^{-0.5x} + C_2e^{-3x}$$

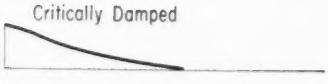
We will use the method of undetermined coefficients to find the particular solution. The proceduce follows: Assume $y = Ax + B$. Differentiating, we

Find System Stability by Evaluating Coefficients of Differential Equations, Fig. 1

Fundamental Second Order Linear Equation with Constant Coefficients: $a_0y'' + a_1y' + a_2y = 0$
Assume roots are: $-b_1 \pm \sqrt{b_1^2 - b_2^2}$ where $b_1 = a_1/2a_0$; $b_2 = \sqrt{a_2/a_0}$, $b_2^2 > 0$

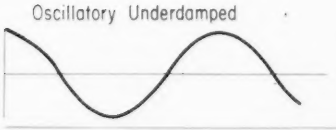


Condition: $b_1 > b_2$, $b_1 > 0$
Solution: Let $b_3 = b_1 - \sqrt{b_1^2 - b_2^2}$; $b_4 = b_1 + \sqrt{b_1^2 - b_2^2}$
Then $y = C_1e^{-b_3x} + C_2e^{-b_4x}$
Note: Overdamped system giving exponentially decreasing motion.

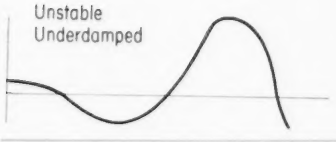


Condition: $b_1 = b_2$, $b_1 > 0$
Solution: $y = (C_1 + C_2x)e^{-b_1x}$
Note: Critically damped system.

Condition: $0 < b_1 < b_2$
Solution: Let $\omega = \sqrt{b_2^2 - b_1^2}$
Then $y = [C_1 \cos \omega x + C_2 \sin \omega x]e^{-b_1x}$
or $y = C_1e^{-b_1x} \cos(\omega x + C_2)$
Note: Underdamped system giving damped oscillatory motion.



Condition: $b_1 < b_2$, $b_1 = 0$
Solution: $y = C_1 \cos b_2x + C_2 \sin b_2x$
or $y = C_1 \cos(b_2x + C_2)$
Note: Underdamped system giving undamped oscillatory motion.



Condition: $b_1 < 0 < b_2$, $b_1^2 < b_2^2$
Solution: Let $\omega = \sqrt{b_2^2 - b_1^2}$
Then $y = (C_1 \cos \omega x + C_2 \sin \omega x)e^{-b_1x}$
or $y = C_1e^{-b_1x} \cos(\omega x + C_2)$
Note: Underdamped system giving exponentially increasing oscillatory motion.

Condition: $b_1 < 0 < b_2$, $|b_1| > |b_2|$
Solution: Let $b_3 = b_1 - \sqrt{b_1^2 - b_2^2}$; $b_4 = b_1 + \sqrt{b_1^2 - b_2^2}$
Then $y = C_1e^{-b_3x} + C_2e^{-b_4x}$
Note: Underdamped system giving exponentially increasing motion.

get $y' = Dy = A$ and $y'' = D^2y = 0$. Substituting the values of y,'' y' and y in the original equation results in

$$2(0) + 7(A) + 3(Ax + B) = x$$

Equating coefficients of like powers of x gives $3A = 1$ and $7A + 3B = 0$. Hence, $A = 1/3$, $B = -7/9$ and $y = x/3 - 7/9$.

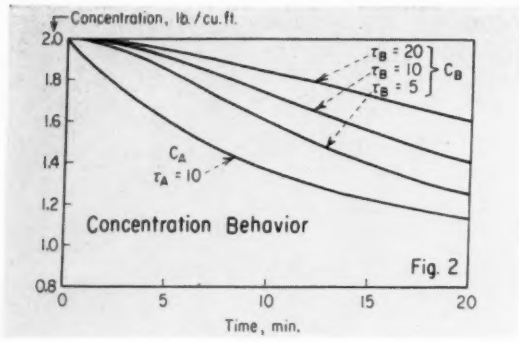
The general solution is then

$$y = C_1e^{-0.5x} + C_2e^{-3x} + x/3 - 7/9$$

Note that the constants C_1 and C_2 are arbitrary. Their values can be determined only when boundry conditions are known.

We have mentioned that there are several forms for the solution of the second order equation. Obviously the particular solution can take many forms, since there is no limitation on the form of the forcing function.

It is less evident that several forms result for the complementary solution. Let us examine the



reason for this. Factor the reduced equation to yield $(D - r)\ (D - r')y = 0$.
If $r \neq r'$:

$$y = C_1e^{rx} + C_2e^{r'x}$$

If $r = r'$:

$$y = (C_1 + C_2x)e^{rx}$$

Where the values of terms in r or r' are complex conjugates or pure imaginaries, a sine-cosine form is preferable for the solution.

The various solutions are summarized in Fig. 1. All have physical significance. We find that the signs and magnitudes of the various coefficients have much to do with system performance and particularly stability.

We now comment on the forms of the forcing function $F(x)$. We generally think of forcing functions when working with control systems. In this case, the x in the above equations becomes time θ; and the y becomes any variable we are trying to measure or control. In control systems, we need to study the transient behavior of a system. This is done by disturbing or forcing the system and observing its performance.

A stable system may return to the initial value. If it is over or critically damped, there is no oscillation. An underdamped system exhibits some oscillation. The amount of oscillation increases as the system tends toward instability.

Consequently, in reading about control applications, frequent reference is seen to the step input, ramp input, displaced cosine, parabolic change and sine wave. It is not within our scope to present the solutions for such cases here. A complete discussion of these solutions is given by C. S. Draper, W. McKay and S. Lees in "Instrument Engineering," Vol. 2, McGraw-Hill Book Co. (1953).

Problems Illustrate Methods

In the problems that follow we illustrate the types of solutions which can be obtained. We also explain the physical significance of the terms in these equations which frequently lead to various system performances.

Problem 2—Solve Problem 1 for the following conditions: $C_{A_o} = C_{B_o} = 2$ lb./cu. ft., $C_i = 1$ lb./cu. ft., $R = 1$ cfm., $V_A = 10$ cu. ft. and (a) $V_B = 5$ cu. ft. (b) $V_B = 10$ cu. ft. (c) $V_B = 20$ cu. ft.

Solution—Defining $\tau_A = V_A/R$, we write the equation for C_A in all cases as:

$$(\tau_AD + 1)C_A = C_i \qquad (18)$$

Thus the general solution is

$$C_A = C_i + C_1e^{-0.1\theta} \qquad (19)$$

Substituting $C_i = 1$ and the known boundary values $\theta = 0$ and $C_{A_o} = 2$ in Eq. (19), we find $C_1 = 1$.

$$C_A = 1 + e^{-0.1\theta} \qquad (20)$$

We test Eq. (20) by noting that as θ approaches infinity, C_A must approach C_i which is 1.

For C_B, we write the general equation

$$(\tau_AD + 1)(\tau_BD + 1)C_B = C_i \qquad (21)$$

where $\tau_A = 10$ and $\tau_B = 5$, 10 or 20 for each case.

By referring to Fig. 1, we write the equations:

(a) $C_B = C_i + C_1e^{-0.1\theta} + C_2e^{-0.2\theta}$ (22)

(b) $C_B = C_i + (C_1 + C_2\theta)e^{-0.1\theta}$ (23)

(c) $C_B = C_i + C_1e^{-0.1\theta} + C_2e^{-0.05\theta}$ (24)

To find boundary values for these cases, we need two conditions. We know that when $\theta = 0$, $C_B = C_{B_o} = 2$. This is one condition. Another possibility is as θ approaches infinity C_B approaches C_i. This is true in all cases, but does not allow evaluation of one of the constants.

We now turn to a very valuable technique for such cases. The derivative at some point is known and can furnish the other boundary condition. The derivative $dC_B/d\theta$ must equal zero when θ is zero.

Thus for each case:

(a) $C_B = 1 + 2e^{-0.1\theta} - e^{-0.2\theta}$ (25)

(b) $C_B = 1 + (1 + 0.1\theta)e^{-0.1\theta}$ (26)

(c) $C_B = 1 - e^{-0.1\theta} + 2e^{-0.05\theta}$ (27)

In Fig. 2 we plot curves of C_i, C_A and the three cases for C_B. Several important points are noted. First, the larger the V/R ratio for tank B, the more slowly it responds. This is in agreement with our knowledge of the physical behavior of such a system. Then all curves for tank B show a zero slope at zero time. All the curves have an inflection point, and eventually approach a value of one asymptotically.

We also consider the dynamics of such a system. Mathematically, the cases for V/R equal to five or 20 are overdamped; when V/R is ten, the system is critically damped. We know this from the forms

For More Information

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of the solutions. It is difficult to imagine such a thing as damping in these systems.

However, when we consider the significance of underdamping in a mechanical system, we see that it is related to a tendency of the system to overshoot a new equilibrium condition and to oscillate. This cannot happen in our tank problem. There is no possible way for the concentration in either tank to exceed the limits of concentration of one and two lb./cu. ft. Thus, we recognize intuitively that we are dealing with a system that is either overdamped or critically damped.

In the previous example, we used a second-order equation to express the performance of the second first-order system in series. Many physical systems are inherently second-order. Such is the case for a mass suspended by a spring.

Problem 3—Solve the equation for the motion of a mass suspended by a spring for the following conditions: $W = 1$ slug; $d = 6$ lb_f./ft.-sec. and $k = 18$ lb_f./ft. See *Chem. Eng.*, Oct. 1957, p. 298 for development of the equation. The mass is initially held at a value of $x = 1.0$ when time $\theta = 0$. Also $dx/d\theta = 0$ and $d^2x/d^2\theta = 0$.

Solution—The equation for this system is

$$d^2x/d\theta^2 + (d/W)\,dx/d\theta + (k/W)x = g \qquad (28)$$

$$[D^2 + (d/W)D + (k/W)]x = g \qquad (29)$$

The roots of the reduced equation are $-3 \pm 3i$ where $i = \sqrt{-1}$. Thus the complementary solution is $[C_1 \sin(3\theta) + C_2 \cos(3\theta)]e^{-3\theta}$. The particular solution is $g/(k/W) = 1.7889$.
And the general solution is

$$x = 1.7889 + [C_1 \sin(3\theta) + C_2 \cos(3\theta)]e^{-3\theta} \qquad (30)$$

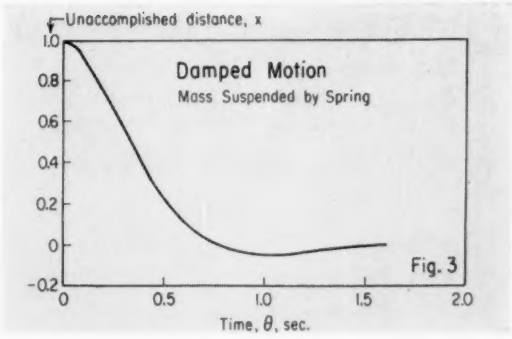
We must now evaluate boundary conditions to find the numerical values of the constants. When $\theta = 0$, $x = 1.0000$. Substituting these values in Eq. (30) gives us one constant. We find the other by noting that when $\theta = 0$, $dx/d\theta = 0$. Hence differentiate Eq. (30) and set equal to zero to find the other constant. The complete equation is

$$x = 1.7889 - 0.7889[\sin(3\theta) + \cos(3\theta)]e^{-3\theta} \qquad (31)$$

We may rewrite Eq. (31) in the form of unaccomplished distance travelled.

$$X = \frac{x - x_\infty}{x_o - x_\infty} = [\sin(3\theta) + \cos(3\theta)]e^{-3\theta} \qquad (32)$$

The results of this calculation are shown in Fig. 3.



Note that here we have an underdamped, stable system and that the weight stops moving after a short time. In this case it is damped sufficiently so that the initial potential energy of the weight is rapidly dissipated.

We might examine the physical significance of this. If the weight were completely undamped, it behaves as an underdamped oscillatory system. It can not under any circumstance become unstable. As the weight moves up and down, energy is transferred between the weight and the spring. Such a system is conservative. Unless energy is added to the system, its total energy content can not increase. Hence, it has no way of becoming unstable.

The examples we have considered are the so-called lumped-parameter problems. We have thought of tanks, spring and weights where all the properties can be assigned to a point. There are many cases where we find distributed parameters.

For example in diffusion and in heat transfer by conduction, we find a continuous distribution of energy or material through a medium. Physically the situation differs greatly from the lumped-parameter cases. Often, however, the mathematical expressions are the same.

Problem 4—One end of a long thin iron rod is at t_o deg. F. The rod projects into air at a temperature of t_a deg. F. What is the equation that defines the steady-state temperature distribution along the rod?

See *Chem. Eng.*, Sept. 1957, p. 292 for development of the required differential equation which follows:

$$d^2T/dx^2 - \lambda^2 T = 0 \qquad (33)$$

where x = distance, $T = (t - t_a)$ and $\lambda^2 = hP/kA$.

Solve the problem for three cases: (I) the end of the rod loses heat to the air, (II) the end of the rod is insulated and (III) the end of the rod is held at air temperature. All these statements refer to the end of the rod where $x = L$. Where $x = 0$ the temperature is held constant at t_o.

Use the following physical constants: $A = 0.00031416$ sq. ft.; $h = 2$ Btu./hr.-sq. ft.-deg. F.; $k = 26$ Btu./hr.-ft.-deg. F.; $L = 1$ ft. and $P = 0.062832$ ft. The values for A and P refer to a rod whose radius is 0.01 ft.

Solution—To solve the equation which follows:

$$d^2T/dx^2 - \lambda^2 T = 0 \qquad (34)$$

write in operator form, $(D^2 - \lambda^2)\,T = 0$. Hence

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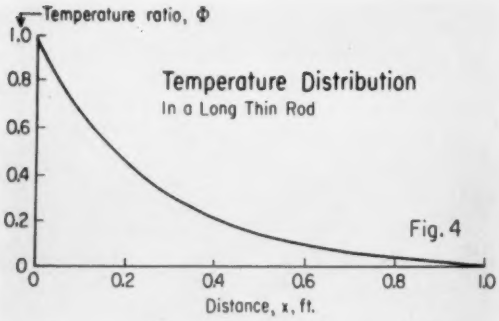

x	ϕ^* Case I	ϕ Case II	ϕ Case III
0	1.0000	1.0000	1.0000
0.2	0.4570	0.4570	0.4557
0.4	0.2100	0.2101	0.2065
0.6	0.0990	0.0991	0.0910
0.8	0.0520	0.0524	0.0344
1.0	0.0388	0.0396	0

*$\phi = (t - t_a)/(t_o - t_a)$

we can say $(D + \lambda)\ (D - \lambda)\ T = 0$. Therefore,

$$T = C_1 e^{\lambda x} + C_2 e^{-\lambda x} \tag{35}$$

To evaluate the constants, C_1 and C_2, we must decide upon two boundary conditions for the system. One condition is that at $x = 0$, $t = t_o$ or $T = (t_o - t_a)$. Hence

$$t_o - t_a = C_1 + C_2 \tag{36}$$

This condition applies to all three cases.

Case I—When the end is exposed to air, heat is lost from the end of the rod. Since the heat transfer is steady state, heat must be lost at the same rate as it is transferred to the end of the rod. Thus

$$-kA(dt/dx)_{x=L} = hA(t_{x=L} - t_a) \tag{37}$$

Using Eq. (35), we can also write

$$-[\lambda C_1 e^{\lambda L} - \lambda C_2 e^{-\lambda L}] = h/k[C_1 e^{\lambda L} + C_2 e^{-\lambda L}] \tag{38}$$

Solving Eqs. (36) and (38), we find that

$$C_1 = (t_o - t_a)\left[\frac{-(h/k - \lambda)e^{-\lambda L}}{(h/k + \lambda)e^{\lambda L} - (h/k - \lambda)e^{-\lambda L}}\right]$$

$$C_2 = (t_o - t_a)\left[\frac{(h/k + \lambda)e^{\lambda L}}{(h/k + \lambda)e^{\lambda L} - (h/k - \lambda)e^{-\lambda L}}\right]$$

Hence our equation for case I is

$$\left[\frac{t - t_a}{t_o - t_a}\right] = \phi$$

$$\phi = \left[\frac{h/k \sinh \lambda(L-x) + \lambda \cosh \lambda(L-x)}{h/k \sinh \lambda L + \lambda \cosh \lambda L}\right] \tag{39}$$

Case II—When the end of the rod is insulated, the temperature gradient at this end must be zero. Otherwise heat accumulates and we won't have a steady-state situation. Here,

$$(dt/dx)_{x=L} = 0 = \lambda C_1 e^{\lambda L} - \lambda C_2 e^{-\lambda L} \tag{40}$$

Solving Eqs. (36) and (40), we find that

$$C_1 = (t_o - t_a)\left[\frac{e^{-\lambda L}}{e^{\lambda L} + e^{-\lambda L}}\right]$$

$$C_2 = (t_o - t_a)\left[\frac{e^{\lambda L}}{e^{\lambda L} + e^{-\lambda L}}\right]$$

Our equation for case II is then

$$\left[\frac{t - t_a}{t_o - t_a}\right] = \phi = \left[\frac{\cosh \lambda(L - x)}{\cosh \lambda L}\right] \tag{41}$$

Case III—If the end of the rod is held at temperature t_a, then:

$$0 = C_1 e^{\lambda L} + C_2 e^{-\lambda L} \tag{42}$$

By solving Eqs. (36) and (42), we find that

$$C_1 = (t_o - t_a)\left[\frac{-e^{-\lambda L}}{e^{\lambda L} - e^{-\lambda L}}\right]$$

$$C_2 = (t_o - t_a)\left[\frac{e^{\lambda L}}{e^{\lambda L} - e^{-\lambda L}}\right]$$

Hence for Case III, the equation is

$$\left[\frac{t - t_a}{t_o - t_a}\right] = \phi = \left[\frac{\sinh \lambda(L - x)}{\sinh \lambda L}\right] \tag{43}$$

Numerically the equations reduce to these forms:

Case I $\phi = 0.0007611 \sinh 3.9224(1 - x) + 0.038811 \cosh 3.9224(1 - x)$ (44)

Case II $\phi = 0.039572 \cosh 3.9224(1 - x)$ (45)

Case III $\phi = 0.039603 \sinh 3.9224(1 - x)$ (46)

In Fig. 4, we show a plot for these results. Only one line is shown since all the values are close.

In this final article of the mathematics refresher, we devoted most of our efforts to the second-order linear differential equation with constant coefficients. We explained the importance of this equation. It results from two first-order systems in series, from inherently second-order systems and from combined phenomena within a system.

We find examples in chemical, mechanical and electrical systems and in combinations of these. The equation is of greatest importance in control systems. It arises in both lumped and distributed parameter systems.

In our analysis of this equation, we have given a brief introduction to the symbolic operator D which greatly simplifies certain manipulations. We have also introduced a symbol τ. In control system theory, it is a standard symbol for a time constant.

Reprints Available

Reprints of this entire six-part CE refresher on mathematical analysis will be available at 75¢.

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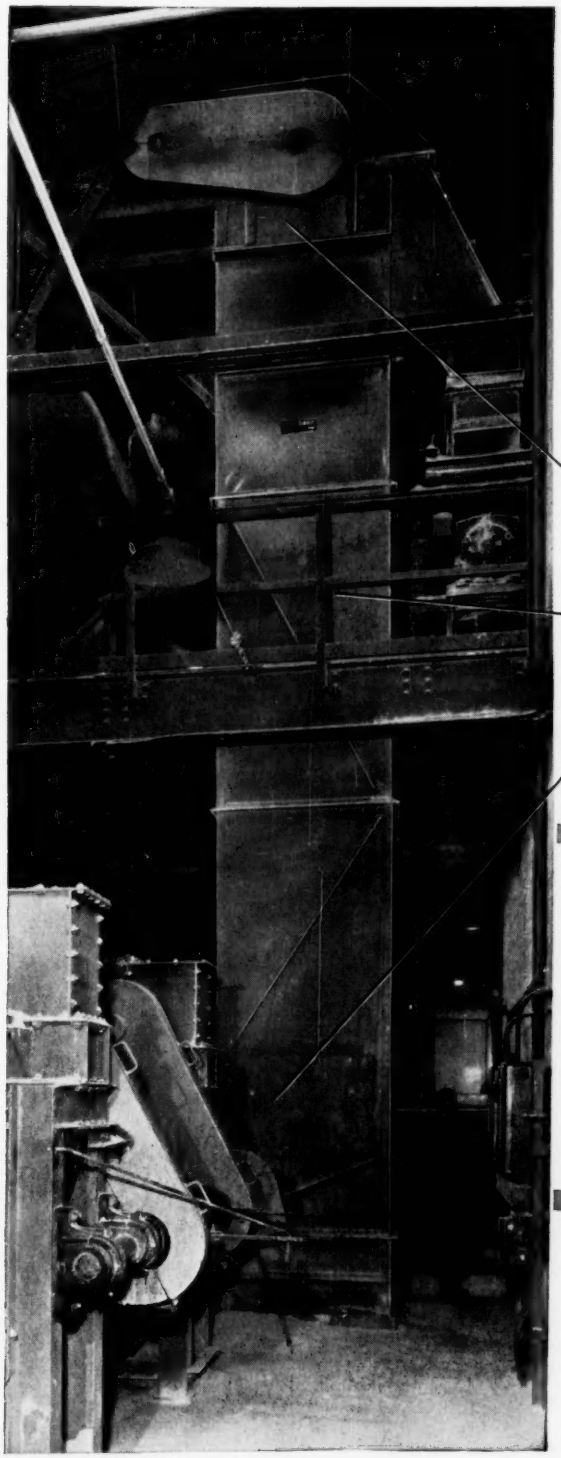
Why alignment is built into LINK-BELT bucket elevators *at the factory... not in the field*



Link-Belt makes and integrates all components to speed assembly

EVER buy a "bargain" bucket elevator—then run into unreasonable installation costs? If so, you'll appreciate the ease with which Link-Belt bucket elevators are assembled. All components are carefully manufactured, assuring ready alignment. And because *Link-Belt makes them all*, they're integrated to match perfectly, operate smoothly.

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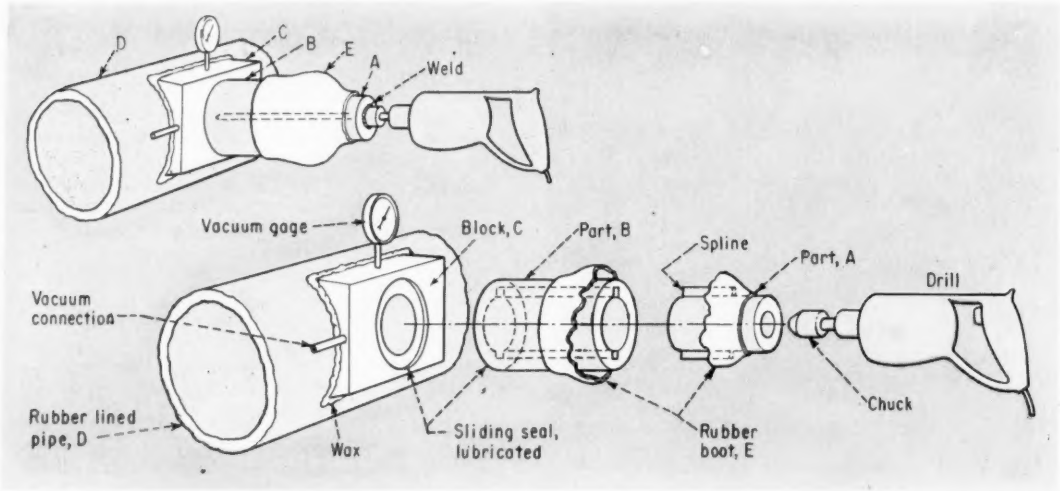
PRACTICE . . .

PLANT NOTEBOOK EDITED BY T. R. OLIVE



Drilling Rubber-Lined Pipe Under Vacuum

Ingenious home-made device prevents lining collapse from atmospheric pressure as drill bites through metal pipe.

Foster Franks
Chemical Engineer, Reichold Chemicals, Inc., Clifton, N. J.

When you have to drill through the wall of a rubber-lined pipe to make a connection, special precautions must be taken if the pipe is under vacuum. You can lose many dollars in "production down-time" if you must shut down. If you drill through without provision to remove atmospheric pressure from behind the lining as it is exposed by the drill opening, then the lining will immediately collapse. Here is a method I have used which enables the work to go ahead without either shut-down or collapse.

Parts *A*, *B* and *C* in the sketch are of metal, machined as shown. Block *C* is machined to fit roughly to the pipe *D*, to which it is secured and sealed with a good vacuum wax. It is provided with two tapped openings, one for a vacuum gage and the other for exhaustion of air by means of a vacuum pump or connection to a vacuum line.

Part *A* is bored to fit over the Jacobs chuck of the drill and is welded or brazed to it. It slides within Part *B* and is keyed to it with splines. Parts *A* and *B* are connected and sealed together with a rubber boot *E* made from an inner tube of similar or smaller diameter. Thus the assembly of *A*, *B* and *E* rotates

---

NEXT ISSUE: How to Construct a Butterfly Valve
By Chesman A. Lee, Winner of the January Contest

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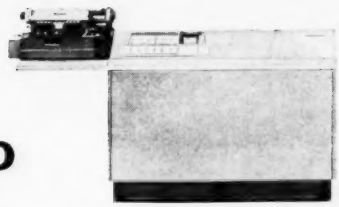

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Max. Speed Add Multiply	 20/sec. 4/sec.	 Comparable to LGP-30	 Comparable to LGP-30	 3/sec. 1/sec.	 Over 440/sec. Over 50/sec.	SPEED EQUAL TO MANY ROOM-SIZED COMPUTERS
Size	17 sq. ft.	6.5 sq. ft. plus table for typewriter.	45 sq. ft.	9.2 sq. ft. plus table for typewriter & control unit.	11 sq. ft.	COMPACT, DESK-SIZED, COMPLETELY MOBILE
Input-Output	Keyboard only — tape at extra cost.	Independent tape preparation at extra cost.	Extra cost peripheral equipment required.	Tape and typewriter for numerical input-output only. Independent tape preparation at extra cost.	Tape typewriter for alpha-numeric input-output standard equipment.	DELIVERED COMPLETE. NO ADDITIONAL EQUIPMENT NEEDED TO PREPARE DATA, PROGRAM OR REPORTS
No. of tubes	165	450	2,000	248	113	FEWER COMPONENTS MEAN LESS MAINTENANCE, FEWER CHECKOUTS
Voltage	220 V	110 V	220 V	110 V	110V	PLUGS INTO ANY REGULAR WALL OUTLET
Power	2.5 KW	3.0 KW	17.7 KW	1.65 KW	1.5 KW	NO SPECIAL WIRING OR AIR-CONDITIONING REQUIRED
Ease of programming & operation	Not alpha-numeric. No internal program storage.	Alpha-numeric at extra cost. 8 part instruction. Requires computer specialist.	Alpha-numeric at extra cost. Requires computer specialist.	Not alpha-numeric. No internal program storage.	Alpha-numeric. Complete internal program storage. Standard typewriter keyboard. Simplest command structure of all.	EASY TO PROGRAM AND OPERATE.
Cost Sale Rental	 $38,000 $1000/mo.	 $49,500 $1485/mo.	 $205,900 $3750/mo. up	 $55,000 $1150/mo.	 $49,500 $1100/mo.	LOWEST COST EVER FOR A COMPLETE GENERAL PURPOSE COMPUTER

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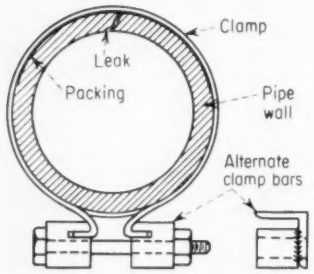
with the drill chuck and *A* slides into *B* as the drill cuts into the pipe.

The faces of Block *C* and rotating Part *B* are smoothly machined and are lubricated with a heavy grease or paraffin to serve as a vacuum-tight rotating seal. A drill long enough to reach the pipe with *A-B* extended is chucked in the drill, the seal at *B-C* is engaged, vacuum is turned on and the drilling proceeds.



Emergency Leak Repair Is Permanent

Buckley Sullivan
Engineer, Cleveland, Ohio.

Illustrated above is an emergency pipe leak repair which is easily made up, yet actually effects a repair that can be left in place permanently.

Take a piece of heavy-gage sheet steel large enough to cover the leak area with a reasonable amount of overlap. Bend each side into a U shape as in the sketch. Then make two clamp bars by slotting two pieces of cold-rolled steel and drilling for a number of clamp bolts. (Or, they can be made by welding a piece of angle iron and bar stock together, as in the detail.)

The patch is assembled by placing a piece of sheet packing over the leak, bending the cover around the pipe, attaching the clamp bars and pulling up the bolts. We last used this patch on a 6-in. pipe. The cover, of 9-ga. steel, was 6 × 18 in. The clamp bars were 2 × 2 in., slotted $\frac{3}{16}$ × $\frac{3}{4}$ in. deep and held together by two $\frac{1}{2}$-in. bolts.

DESIGN NOTEBOOK
Coming April 7

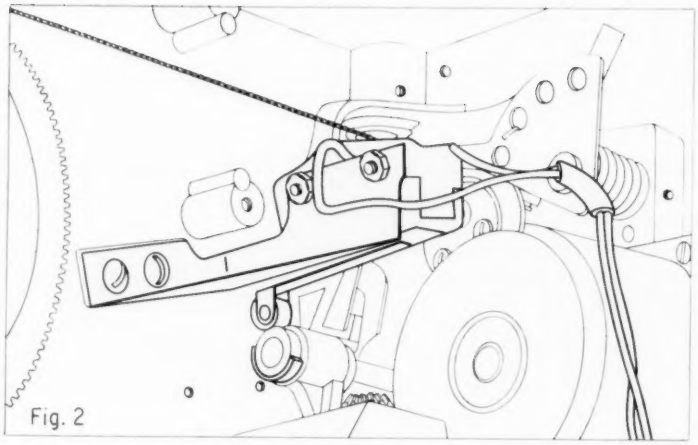


Fig. 2

Temperature Recorder Points Doubled

Robert J. Zellner
Chemical Research Dept., Ansul Chemical Co., Marinette, Wis.

On a recent project we needed to record the temperatures indicated by 15 thermocouples, but only an eight-point recorder was available. In checking the recorder for modification possibilities, we found that this particular Brown potentiometer printed its eight numbers in only one-half revolution of the print wheel and thermocouple selector.

By introducing a cam into the gear train driving the print wheel and thermocouple selector we operated a switch in cooperation with relays so that, in each half revolution, alternate sets of eight temperatures were recorded. How the wiring was done is shown in Fig. 1, while Fig. 2 shows the cam and switch addition.

Switching of the alternating sets of thermocouples was accomplished by two four-pole, double-throw relays connected to the thermocouples as in Fig. 1 (only those connected to Relay 1 being shown). The cam and Microswitch shown in Fig. 2 energize the relays during half a revolution of the selector gear train, thus connecting Thermocouples 1, 2, 3, and so on, to the recorder. During the other half revolution, Thermocouples 1A, 2A, and so on, are connected.

To keep the chart record from being ambiguous the numbers printed during the first half revolution are in a different color from those of the second half. The pilot light, which shows only when one set of thermocouples is connected, also helps to inform the operator of which set is being recorded. In addition, Thermocouple 8 in one series is at room temperature as a further aid in reading the record.

The relay coils are energized from the main instrument switch to insure their being turned off with the instrument.

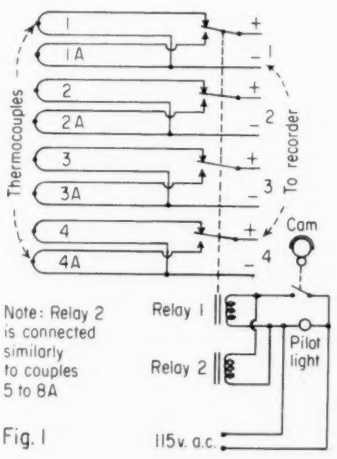


Fig. 1

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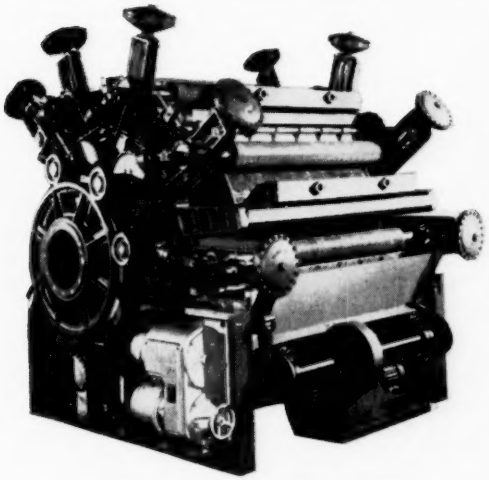
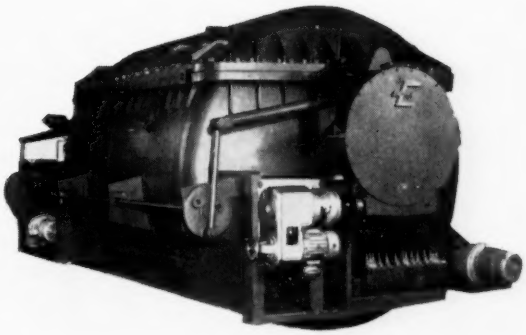
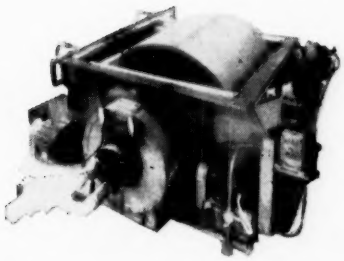


EIMCO CONTINUOUS BICARB WHEEL
Filters in Soda Ash Process (Uses 3, 4 and 5 press rolls)



EIMCO PRESSURE DRUM WITH REPULPER
Handles flammable material



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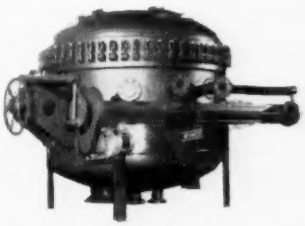
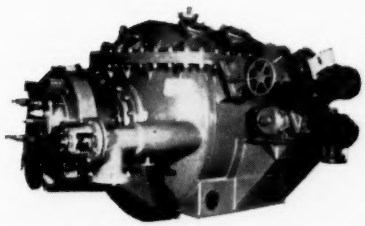
Eimco responded by giving each request **individualized** attention. We utilized "pre-analysis" information provided by competent Eimco Sales Engineers; complete, modern test facilities and data at the Eimco Research and Development Center, and know how and experience of skilled Eimco Technologists.

Eimco has discovered many new influencing factors in vacuum and pressure filtration, important to the **total** economic picture. A particular vacuum advantage may be offset by a more profitable pressure advantage, elsewhere (or vice versa). Eimco balances these advantages to assure you the most profitable equipment selection from a realistic investment-operating cost standpoint.

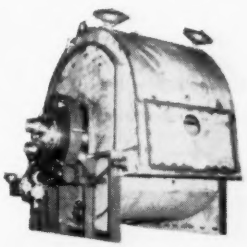
Because **custom design** calls for a high degree of specialization, it is important that you begin by talking over your problem with an Eimco Representative. Let us arrange this meeting at your convenience.



EIMCO PRESSURE DRUM
Deashes coal tar



EIMCO PRESSURE DEWATERER
Filters for a Phenol, Acetone and Alphamethyl Styrene Producer



EIMCO CONTINUOUS VACUUM DRUM
Handles an acrylic polymer slurry

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B-296

Successive, extended tests show which . . .

Special Coatings Will Resist Spillage

R. Cushing, Pittsburgh, Pa.

One big headache in many chemical plants is the vulnerability of painted surfaces to damage by chemical spillage. Just before an inspection by company management, every operator becomes a painter. Within a few days everything in sight is painted, with no regard to atmospheric conditions or to proper surface preparation.

In a great many areas, about four weeks later, most of the equipment will have paint blistered, discolored and generally in poor condition. This is particularly true in pilot-plant areas and where many loading and unloading operations are carried out.

We've looked into this problem and have developed proper techniques for surface preparation and paint application, with recommended paint systems which will save you much time and money. Our 13 recommended coating systems, ranging from phenolics to epoxies, are listed on p. 158.

▶**Stand Chemical Variety**—These coatings withstand chemical spillage of a variety of commonly used acids, alkalis and solvents, without requiring flushing down with water. They also require no unusual surface preparation or skill in application. Operators can paint in their slack periods (climatic conditions have little effect during application). A minimum number of coats is necessary.*

▶**A Rough Test**—Steel test panels were made and numbered (2 in. x 4 in. x $\frac{1}{8}$ in.). They were exposed to the atmosphere to induce rusting. One side of each was wire brushed on a power wheel to bright metal, and the other side wiped with a rough cloth to remove any loose rust. Paint systems were then applied.

After completion of the panels, an "X" was scratched in the upper half of each side of each panel.

The panels (except for some atmospheric exposure tests) were tested sucessively in the 17 common chemicals listed on p. 158.

Twice a day panels were dipped in a chemical and the chemical allowed to evaporate from the surface.

Approximately 20 days were used for each chemical. A record was kept of the number of days before damage to the coating was observed. Differentiation was made between effect on the unbroken surface, the precleaned surface or the rusty surface.

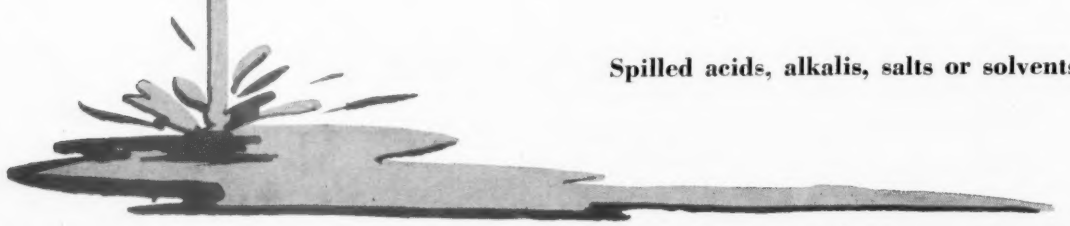
Coatings which failed along the way might have been acceptable for some of the chemicals in which they were not tested. However, this series of successive tests was primarily an elimination procedure to find coatings that would resist all chemicals tested.

The results and ratings of those systems which lasted through the complete program (better than 18 months) are summarized in the table.

An epoxy coating was the only sample rated as 100%. It was entirely unaffected throughout the tests and is available in several colors. It should be pointed out however, that in some cases different colors have less resistance than others for the same basic coating. The color tested in the epoxy coating was grey.

Five other samples had equal resistance to the epoxy coating but were rated 95% because they were only available in black or grey. Four of the successful systems were badly discolored and were given a 15% lower than perfect rating. About 5% was deducted for coatings that were trowelled on. These are more difficult to apply and more expensive.

* Requests for coatings to meet these requirements were sent to 12 paint companies. Eight submitted samples but offered no guarantee of success.



Spilled acids, alkalis, salts or solvents

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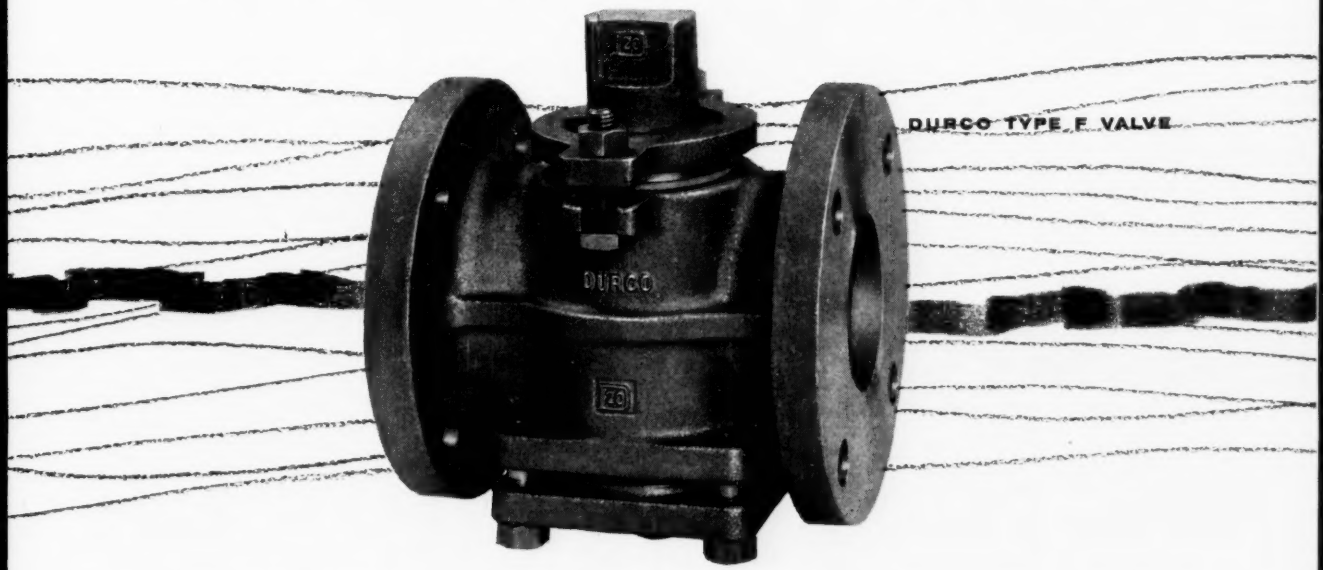
on maintenance run to thousands of dollars at

Michigan Chemical Corporation • Saint Louis, Michigan



Previous valves on a chlorinator manifold at Michigan Chemical Corporation leaked so badly they required daily re-packing. The leaky valves were replaced in 1952 by Durco Type F valves. These original Type F valves are still in service and they have "resulted in saving thousands of dollars by reducing operating down time and maintenance labor."

Michigan Chemical Corporation is a basic manufacturer of industrial, agricultural, and pharmaceutical chemicals, and is a leading producer of insecticides, bromine, bromides (organic and inorganic) magnesia, salt, and rare earth oxides, compounds, and metals. The installation described here is just one of several Durco valve installations at its Saint Louis, Michigan, plant.

Durco chemical service valves, pumps, and other engineered equipment can probably save money for you.

For answers to your tough corrosion problems, write or call The Duriron Company, Inc., Dayton, Ohio.

DURCO TYPE F VALVES

DURCO CORROSION RESISTING ALLOYS & EQUIPMENT

The mark of dependability in tough chemical service . . . everywhere

THE DURIRON COMPANY, INC. / DAYTON, OHIO

Branch Offices: Baltimore, Boston, Buffalo, Chicago, Cleveland, Detroit, Houston, Knoxville, Los Angeles, New York, Philadelphia, Pittsburgh, and Pensacola, Fla.

Two of the systems did not actually rate as sucessful on all the chemicals tested. They were perfect except for ketones, and they held up for 12-15 days on ketones. It was, therefore, considered worthwhile to mention these (rated at 60%).

► **Important Painting Rules**—This type of test cannot be absolute in nature.

However, like the results of operational tests, which yield a band of test points across a graph, a definite trend can be established.

Based on the results of these tests, and on approved and tested methods of application, we can recommend some rules for chemical plant equipment painting.

The most practical, most common method for repainting jobs is sanding, or power wire brushing. However, expected service life of coatings applied over this type of surface preparation will be less than 40% of the life of the same coating applied over a properly sandblasted or Parkerized surface.

Sanding or wire brushing is satisfactory only on a relatively smooth, relatively clean surface with a very conscientious painter. The fact remains however, that 90% of in-place plant maintenance painting must be done by this method, so great emphasis should be given to proper sanding or brushing.

► **Applying Prime Coats**—Where possible, primers should be applied at the steel manufacturer's or fabricator's plant. However, asking for one shop coat of red lead without specifications is a waste of money. Most manufacturers will apply a shop coat, costing about $2/gal., consisting mostly of fillers and hiding pigment.

When ordering equipment, specify the shop coat and surface preparation in detail, and be willing to pay for this. Cost of inhibitive pigment is twice that of hiding pigment. A good primer consists of full bodied (unthinned) vehicle and inhibitive pigments only, with no extenders or hiding pigment. It follows then, that primer will be more expensive than a standard black or white finish coat, if both are of good quality.

Consistency of primer should

Chemicals Used in Tests

Acids
- Acetic, dilute & glacial
- Citric
- Oxalic
- Hydrochloric, dilute & conc.
- Sulfuric, dilute & conc.
- Nitric, concentrated

Alkalis
- Sodium hydroxide sols.
- Potassium hydroxide sols.
- Ammonium hydroxide sols.
- Versene (ethylenediaminetetraacetic acid)

Salts
- Calcium chloride brine, 20%

Solvents
- Methanol
- Ethanol
- Butanol
- Acetone
- Methyl ethyl ketone
- Methyl isobutyl ketone

High-Rated Coatings Stand Up to Acids, Alkalis and Solvents

Base of Primer	Coats	Mils	Method	Finish	Coats	Mils	Method	Rating, %
	1	2	Brush	Phenolic gray	1	2	Brush	95
	1	2	Brush	Phenolic black	2	4	Brush	95
Phenolic orange	2	4	Brush	None				80
	2	5	Brush	None				80
	1	3	Brush	Phenolic brick red	1	2	Brush	60
	2	3	Brush	Furane-chloride	1	4	Trowel	70
Neoprene	2	3	Brush	Furane	1	4	Trowel	85
	2	3	Brush	Furane	1	2	Brush	95
Zinc-rich	2	3	Brush	Esterified epoxy	2	2	Brush	95–100
	2	2	Brush	Elastomer	3	3	Brush	70
Epoxy	2	2	Brush	Epoxy grey	2	3	Brush	80
Zinc-rich followed by epoxy	2 1	2 1	Brush Brush	Epoxy grey	3	3	Brush	60
Esterified epoxy	3	3	Brush	Esterified epoxy	2	2	Brush	65

US RUBBER PERMOBOND LININGS

How to prevent salty drinkers from getting "ulcers"

The modern Linden, N. J., plant of General Aniline & Film Corporation produces, each day, many tons of chlorine and caustic. The 4 brine inlet filters and brine storage tanks (pictured above) and miscellaneous brine-handling equipment—plus the plant's 52 electrolyzers, all are lined with U. S. Permobond® protective rubber especially developed and compounded for resistance to chlorine and caustic solutions. *Without this Permobond protection, the corrosive solutions would attack and destroy the metal.*

In addition, Permobond was installed and vulcanized in the six caustic storage tanks, right on the job—an example of the versatility and adaptability of the Permobond process and "U.S." field engineering service.

"The 'U.S.' men completed their job in record time, both here and in other installations," says Mr. J. F. Leimgruber, Construction Superintendent for Blaw-Knox, Inc., designers and builders of the plant.

You can also have Permobond installed as *original equipment* on anything that conveys or contains corrosive chemicals—piping, tanks, valves...in your own plant or at the steel fabricator. And where special conditions occur, a wide range of synthetic Permobond lining stocks is available.

U. S. Permobond—plus expert engineering assistance—is obtainable from any of our 28 District Sales Offices, or write us at Rockefeller Center, New York 20, N. Y.

In Canada, Dominion Rubber Co., Ltd.

US RUBBER Mechanical Goods Division

United States Rubber

SEE THINGS YOU NEVER SAW BEFORE. VISIT U.S. RUBBER'S NEW EXHIBIT HALL, ROCKEFELLER CENTER, N.Y.

be adjusted according to the temperature to give a 1-1.5 mil thickness per coat (dry film). Give specification of coats in dry film thickness rather than number of coats alone.

Also, brush application of the prime coats is preferred. An intermediate touch-up prime coat should be given before the second full prime coat is applied.

Film thickness should be measured with a pocket-type Elcometer or equal.

▶**Then Finish Coatings**—The principle of a "wet edge" is desired in applying finish coats. This means a wet coat is never applied on a partially converted or dry edge. Panel tests show that a wet coat applied on an incompletely cured surface will blister by forming a bond between the wet and partially dry coats; or it will weaken the initial bond between the partially dry coat and the metal.

Allow full conversion or drying time, under the conditions actually experienced, between coats. This will usually be longer than the manufacturer's recommendation based on ideal drying conditions.

If spray painting, use two strokes of the gun for each coat. Reduce the sweep to allow for the wet edge principle. And make the first sweep horizontal, then the second sweep vertical.

Offshade the second prime coat to produce a visible shade difference. Offshade the first finish coat by addition of black or white.

Plan your painting so the day's work ends at an edge. Then overlapping of wet on dry will not occur the next day, unless it is certain that full conversion will occur overnight.

Apply finish coats at a full 1.5 mil thickness per coat. Then apply 2 finish coats after 2 prime coats. If 3 coat system is used, make it 2 prime coats at 1.5 mils and 1 finish coat at 2 mils. A final 5 mil thickness is the minimum to be accepted in most situations.

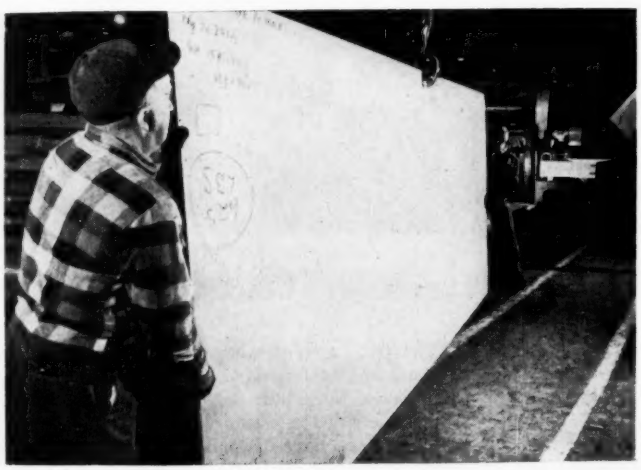
Use normal maintenance paints only above 40F., when no drop in temperature is anticipated, and humidity is less than 65%. Surface condensation when the temperature drops inhibits drying and reduces gloss. Presence of moisture, when humidity is too high, prevents adhesion and forms nuclei for corrosion and water bubbles between coats.

▶**Schedule Touch-Up**—With proper initial surface preparation, cleaning to base metal need not be done each time an area is painted.

A schedule should be established to inspect painted surfaces at definite intervals. Local wire brushing, spot priming, and finish coat renewal should be done as soon as inspection shows the barest beginning of local failure.

If cleaned metal surfaces are always protected by a sound, continuous, protective-paint film, paint life can be extended.

Paint systems applied under the above rules should provide 6-7 years protection rather than the usual 2-3 years.



King-Sized Titanium Plate Produced for Chemicals

One of the largest pieces of light-gage titanium plate ever produced was recently rolled by Titanium Metals Corp.

Made of Ti-75A alloy, the plate measures 75 x 224-in., weighs 625 lb. Nominal thickness is 3/16-in. An average size for titanium sheet is 36 x 72-in.

Proving it can be done, TMCA looks to the chemical industry as a potential market for large Ti plate, particularly for reactor vessels.

Recent Advances in Powder Metallurgy

Detailed information on new developments in powder metallurgy are available now in printed form. Based on the Thirteenth Annual Meeting of the Metal Powder Assoc., the procedings report on the new superfine powders and chemically precipitated nonferrous powders.

Chemical precipitation permits production of nonferrous materials directly from low-grade ores, bypassing smelting operations. Now nonferrous strip metal can be produced from metal powders at substantial cost reductions.

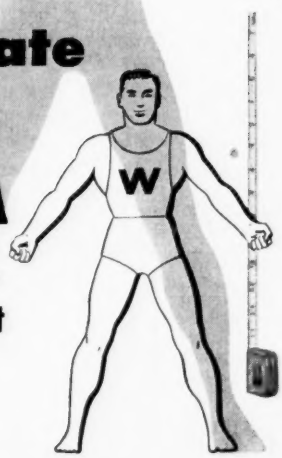
Copies of the proceedings are available from the Metal Powder Assoc., 130 W. 42nd St., N.Y.C., in two volumes. Volume I (General) is $4.00. Volume II (Ferrites and Electronic Core) costs $3.00.

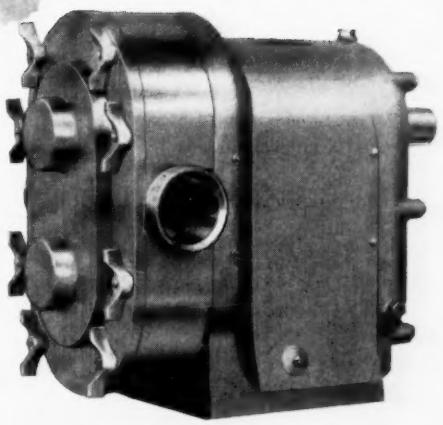
Now, a giant in capacity...

yet moderate in size

WAUKESHA

The New 200-D.O. Corrosion-resistant P.D.* Pump 300 G.P.M.





*Positive Displacement

Ever-growing production demands by industries requiring corrosion-resistant positive displacement pumps, led WAUKESHA Engineers to develop this enormously thirsty addition to the WAUKESHA family.

If there are higher capacity pumps of this type, we've never heard of them.

The 300 G.P.M capacity is the maximum. 285 G.P.M. is against 100 p.s.i. 200 G.P.M. is against 150 p.s.i. Against pressures of 100 p.s.i., this youthful giant will faithfully deliver any of these capacities.

And despite this extraordinary pumping production, the new WAUKESHA is only 17 inches high . . . plenty of clearance with minimum floor space required. Super-capacity is gained by large inlet and outlet ports (4 inches in diameter) — a larger impellor, yet a surprisingly small increase in over-all dimensions.

- With the new WAUKESHA 200 D.O. Pump you readily meet today's production requirements with capacity-provision for your future expansion.
- For pumping lines that may need protection against sudden high back pressures, or with accurate delivered capacity into filler bowls the new WAUKESHA 200 D.O. can be furnished with a vented cover.
- In fact, all the user-benefits, all the engineering efficiencies, all the new sealing improvements provided by the WAUKESHA PUMP family are yours in the new WAUKESHA 200 D.O.

Send for the Bulletin describing the new WAUKESHA No. 200 D.O. corrosion-resistant Pump. Just a postcard will do.

ONLY Waukesha gives you a quarter century's experience and reliability

A 3

Waukesha FOUNDRY COMPANY

DEPT U-2, WAUKESHA, WISCONSIN

CB&I TANKS

ON CORROSIVE SERVICE AT SOUTHERN NITROGEN

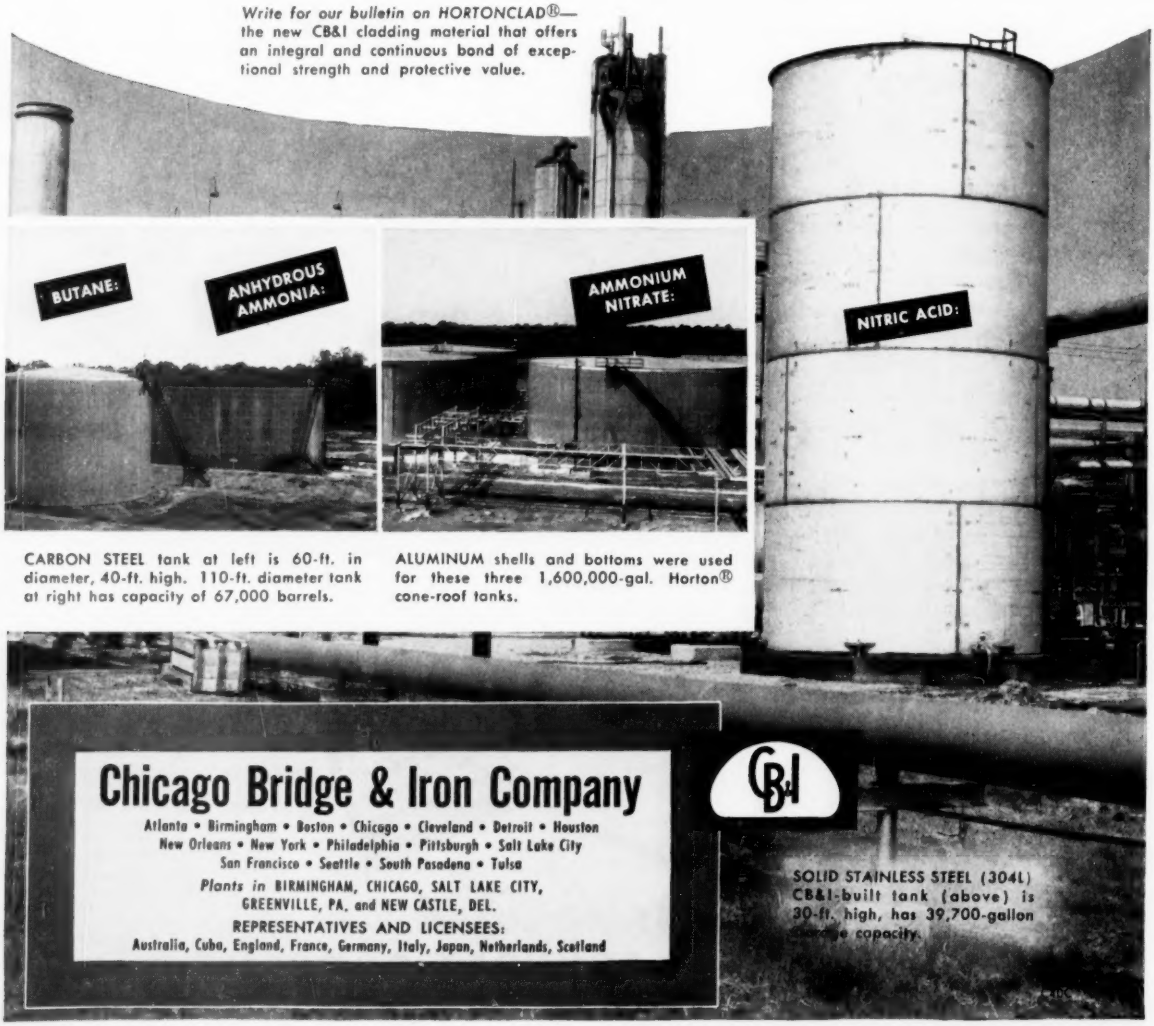
Special metals help prolong tank life at Southeast's first basic nitrogen plant.

Southern Nitrogen Company's $14,000,000 plant at Savannah, Georgia, is designed to provide southeastern states with a nearby, economical source for a full line of basic nitrogen products.

To insure maximum performance life for tanks used to store a variety of highly corrosive materials which are produced or handled in the plant processes, CB&I specialists worked closely with the Girdler Company (General Contractors) and Southern Nitrogen officials. Carbon steel, solid stainless steel, aluminum and other combinations of corrosion resistant metals and alloys were used.

The handling of special metals, including design of structure, fabrication and erection, is a specialty and an art with CB&I. As a result, the "little" engineering or structural refinements that mean a *lot* in overall plant performance—have become an integral part of any welded steel structure that is furnished by CB&I.

Write for our bulletin on HORTONCLAD®—the new CB&I cladding material that offers an integral and continuous bond of exceptional strength and protective value.



CARBON STEEL tank at left is 60-ft. in diameter, 40-ft. high. 110-ft. diameter tank at right has capacity of 67,000 barrels.

ALUMINUM shells and bottoms were used for these three 1,600,000-gal. Horton® cone-roof tanks.

SOLID STAINLESS STEEL (304L) CB&I-built tank (above) is 30-ft. high, has 39,700-gallon storage capacity.

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
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Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY, GREENVILLE, PA. and NEW CASTLE, DEL.

REPRESENTATIVES AND LICENSEES:
Australia, Cuba, England, France, Germany, Italy, Japan, Netherlands, Scotland

CB&I

Chemical Engineering

People

FEB. 24, 1958

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FMC's Frederick A. Gilbert is now president of Westvaco Chlor-Alkali as well as Becco Chemical. What's more, he's a member of the chemical divisions' operating committee.

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Borden's Chemical Div. is now known as Borden Chemical Co. . . . Lea-Michigan, Inc., has purchased the Industrial Lubricants Co. . . . Chempro, Inc., is a new consulting firm.

New Team . . .

TITANIUM AND ZIRCONIUM

for your corrosion problem areas

TYPICAL CORROSION RESISTANCES OF ZIRCONIUM AND TITANIUM

CORROSIVE MEDIA	METAL RESISTANCE	
	ZIRCONIUM	TITANIUM
Sulfuric Acid	excellent to good below 80%	good below 5%
Nitric Acid	excellent	excellent
Hydrochloric Acid	excellent	good below 10%
Phosphoric Acid	excellent to fair below 85%	poor
Chromic Acid	excellent	excellent to good
Aqua Regia	poor	excellent
Wet Chlorine Gas	poor	excellent
Chlorine Water	excellent	excellent
Sodium Hydroxide	good below 90%	good below 50%
Ferric Chloride	poor	excellent
Calcium Chloride	excellent	excellent
Cupric Chloride	poor	excellent
Sodium Chloride	excellent	excellent
Ammonium Chloride	excellent	excellent
Aluminum Chloride	excellent	excellent to fair

Chart shows corrosion resistances of zirconium and titanium to typical chemicals.

Steam jet made of zirconium, which has given trouble-free performance after a year in hydrochloric acid service. For comparison, a throat piece from a steam jet (below) is shown after only a week of similar service.

By specifying titanium or zirconium for processing equipment, you can now overcome most of the corrosive media which attack other metals.

Even with such hard-to-handle chemicals as chlorides and oxidizing acids, equipment can have extremely long service life when made from these corrosion-resistant materials. Problems of product contamination in chemical and food processing can also be virtually eliminated.

Mallory-Sharon is in position to offer you *both* titanium and zirconium mill products for equipment fabrication—plus engineering assistance and unbiased recommendations on the most suitable material.

Titanium is now available from stock in a complete range of mill products, may be readily fabricated, and more than pays its extra cost where ordinary metals fail. Zirconium facilities are being rapidly increased, and mill shapes are now in production.

For information on the corrosion-resistant properties of titanium or zirconium write Mallory-Sharon Metals Corporation, Niles, Ohio.

MALLORY-SHARON

METALS CORPORATION • NILES, OHIO

Integrated producer of Titanium • Zirconium • Special Metals

One of our most popular authors returns to give you his tested and reliable list of . . .

Six Sure Steps to the Top

O. A. Battista, American Viscose Corp., Marcus Hook, Pa.*

Most of us can use more money these days. But more so than ever before, promotions are not handed to you because you're a nice fellow looking for one. Competition for advancement up the ladder of success is keener than ever.

Over the years, I have seen some men climb up the ladder of success and others slide down. I've analyzed both operations, and if you are interested in climbing higher or you are wondering why you're losing your grip on the success ladder, my notes may be valuable to you as they have been to me.

Let Others Do Things For You

Every man that I have studied on his way up was able to somehow get things done through people.

The knack of doing this is to work calmly—but calculatedly—to bring out the best in others without bringing yourself into their spotlight. If you do everything you can to help others get the credit, you never will have to worry about getting the credit yourself.

Use Both Your Ears

There's no better way to line people up behind you than by making solid friends out of them. And nobody has yet found a more reliable way of making friends than by stopping, looking and listening eagerly to people.

When people know their ideas are not going to be stolen, their minds work overtime to dig new ones up; and what boss is there who doesn't like to see his associates help him get a promotion?

The best way to get ahead in most cases still is to do everything you can to help your boss get a promotion. The more your boss comes to depend on you, the more indispensable you will be to him as he climbs the ladder of success.

Beware of Detailphobia

Some men give careful and competent attention to detail; but the person who is lost in a maze of details is doomed to mediocrity. Of course, certain matters of immediate moment require quick decisions followed by immediate action.

Show Obedience, Loyalty

Let your boss down, buck him, belittle him behind his back, or do something to make him feel you're not giving him the support he can rightfully expect of you, and you can be court-martialed just as decisively as you

* Meet your author on p. 174.

might for desertion while under fire and in uniform.

Ladder-climbing requires that you look at your superiors on the rungs above you as persons with more experience and training who you can respect and from whom you can learn. When they direct you to do something, you don't resent it; you go ahead and do it, figuring that they know more about it than you do.

Similarly, when you are criticized, take it on the chin cheerfully and do not feel indignant nor injured. Take the attitude that your boss is calling attention to your mistakes because he is trying to train you to be more efficient on your job and more useful to him. If he did not think you were worth training, he wouldn't bother to criticize. He would get rid of you and try someone else.

Give Out the Facts

Give the other fellows the facts. Some of the worst bosses I've known failed because their communications were poor. One of the soundest of all administrative principles is to let employees know the whys and wherefores of every action that affects them.

People who work under your direction have an almost insatiable curiosity about what happens in top-level and middle-management meetings. They will do a better job if they know as clearly as possible just where their work fits into the over-all program.

Obey the Rules

Obey the rules. All the rules, even those you make yourself. It still is common to hear people praise some of the best executives by saying, "He worked hard and never would ask a person to do something he wouldn't do himself if he had to."

In other words, those under you won't do a good day's work unless you do. Setting the pace is a mark of every respected leader. Such qualities as initiative, punctuality, cooperation and carefulness are effectively contagious when they are practiced at the top.

The group leader who works until quitting time the day before a holiday, who keeps the official lunch hours, who doesn't sneak in extra vacation days or take advantage of his position to enjoy privileges beyond the reach of those on lower rungs is doing the things that are bound to put another extension on his own ladder.

There you have the six extras that can push you ahead into a better job and better pay. But remember, these are the extras you'll need over and beyond a thorough knowledge of your present job.

DU PONT PLANS

. . *to Pay More*

Speaking before the National Industrial Conference Board in New York last month, T. E. Weissinger, Du Pont's manager of salary classification, answered some questions about the 1958 crop of new chemical engineering graduates.

According to Weissinger, the supply will not satisfy employer demands and starting salaries will be driven up again. He predicts that June 1958 price tags on new graduates will be up about 3 to 5% over 1957 levels.

Although exact dollar figures were not discussed, it seems rather certain that Du Pont recruiters will be offering in the vicinity of $450 to $475/month during the current campaign.

THIS HAS BEEN

. . . *Your Special Week*

Did you feel any better than usual this past week? You should have. It was National Engineers' Week.

This annual observance is usually scheduled during Washington's Birthday week (Feb. 16-22, this year) under the general sponsorship of the National Society of Professional Engineers.

THIS WILL BE

. . . *Your Best Year*

According to one firm of management consultants, "1958 will be the year of the scientist-engineer ascendancy." M. D. Witty and D. D. Polon of Witty Consultants (New York), after personal interviews with defense officials, have released these optimistic predictions:

"The search for engineers and scientists will be even more intensive than in 1956 and 1957. A major shortage of engineering personnel will prevail."

"Government contracts going to major defense contractors and their thousands of subcontractors will in the early part of 1958, absorb most available scientists, engineers and technical manpower. These men will be scooped up and hoarded by major companies in anticipation of greater defense contracting before the public will be aware of what is happening. It has already started in a very quiet way."

Polon told *CE*, in a telephone interview that, where in past years chemical engineers have not been affected very much one way or the other by defense contracts, the advent of chemical bombers and rocket fuels will sweep us into defense industries and increase our market value.

Next Issue: What Tests Reveal About Young Ch. E.'s

What qualities would you look for before you hired a young chemical engineer into your group? Now, when we have an urgent need to use our technically trained manpower to its best abilities, we need more information about what these abilities are. Here it is from a consultant who has more than 20 years' experience in selecting, testing and appraising people for the chemical industry.

No Excessive Heating

New Rectifier Cooling System Prevents Heat Build-up and Damage

when ac Power Fails

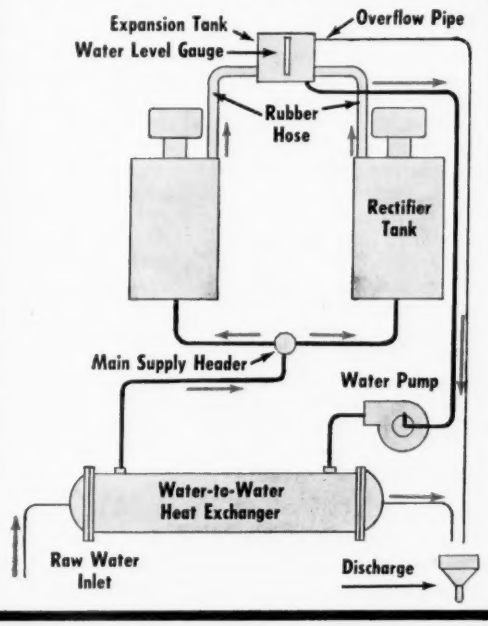
A SAFER, more effective cooling system in the Allis-Chalmers rectifier continues to circulate water *even when an ac power failure stops the water pump.* Heat and steam are dissipated before they can develop to the danger point.

The new system features an expansion tank that extends the full length of the rectifier frame with short vertical connections from each tube. With warm water continuing to flow freely upward, a thermo-siphoning action draws cooler water into the tubes. Build-up of excessive temperatures is prevented. Steam pockets are kept from forming. Subsequent water loss from the recirculating cooling system is minimized.

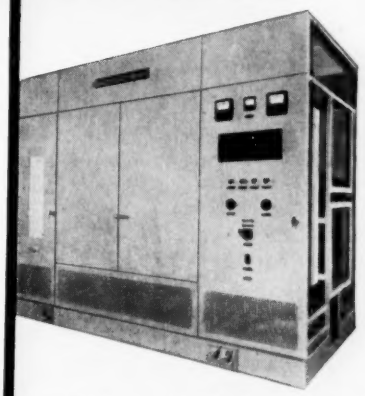
Successful operation in hundreds of installations is your assurance of the complete reliability of Allis-Chalmers mercury arc rectifiers. Contact your nearby A-C office or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.

How the System Works

Water is normally pumped through the water-to-water heat exchanger to the main supply header from where it circulates through rectifier tubes picking up heat. Hot water flows up through the short connections to expansion tank and back down to suction side of water pump.



ALLIS-CHALMERS
Mercury Arc Rectifiers

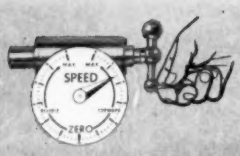


Factory-packaged units cut installation time and costs. Sealed tube rectifiers are supplied in completely enclosed or open types. Here is a typical, completely enclosed, 1000-kw, 250-volt rectifier for steel mill service.

ALLIS-CHALMERS

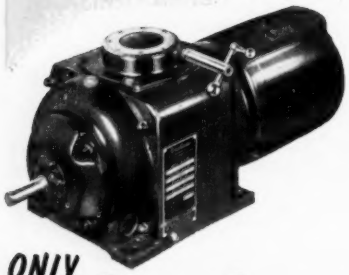
A-C ALLIS-CHALMERS

A-5425



GUARANTEED GREATER ACCURACY

than any other Variable Speed Drive



ONLY **Graham**

most reliable variable speed drive made

offers these...

BIG FOUR FEATURES!

1 UNLIMITED SPEED RANGE — from any desired maximum speed to zero, including reverse, without stopping motor.

2 UNMATCHED ACCURACY — of speed setting and re-setting, and of speed holding.

3 ULTIMATE in SIMPLICITY and COMPACTNESS — a straight line extension of a standard induction motor — or available without motor.

4 AUTOMATED SPEED CONTROL — control tension, proportion, synchronization, etc. from any control signal; 3 to 15 PSI, .5 to 5 ma, potentiometer, frequency, or binary signal from punch cards, tapes, or computers.

SEE OUR CATALOG IN SWEET'S PRODUCT DESIGN FILE OR WRITE FOR COPY

All this backed by **PROVED PERFORMANCE** to do a better job for **LESS MONEY!**

GRAHAM TRANSMISSIONS, INC.
Dept. CE, Menomonee Falls, Wis.

PEOPLE . . .

TECHNICAL BOOKSHELF

J. B. BACON

Is Soviet education really better?

YES **"No special ingenuity of any kind is required to solve [these entrance] examination problems."** ***—Soviet Academician Kolmogorov.***

YES **"Any student succeeding in solving two-thirds of [these problems] would certainly have demonstrated a preparation and ability above the media of our freshman class."—*MIT Mathematics Professor Franklin.***

MAYBE **"Suggests a first-class training program—but all depends on what they really do in their courses."** ***—MIT physicist.***

Myth or Menace?

SOVIET EDUCATION FOR SCIENCE AND TECHNOLOGY. By Alexander Korol. Technology Press of Massachusetts Institute of Technology and John Wiley & Sons, Inc., New York. 513 pages. $8.50.

The above quotes—all taken from Mr. Korol's book—serve to point up various aspects of the problem he confronts.

We know Soviet scientists and engineers have been building an impressive record, especially in the last few months. School systems and methods are apparently turning out competent men in increasing numbers. But we get little unbiased information from iron-curtain spokesmen; sometimes they're downright misleading.

In an exhaustively documented effort, Mr. Korol cuts through party-line jargon and pseudo-statistics to give us an authoritative, balanced picture of the Soviet school process.

The book does not attempt to add fuel to the five-alarm fire ignited by the launching of Sputniks I and II. Nor is it a call to complacency. Mr. Korol shows us some very real weaknesses of Soviet schools, such as overspecialization and overlapping of courses. He shows us, too, that educators and the party are making strenuous efforts to eliminate these weaknesses.

▶ **Some Common Problems**—Although many of the weaknesses—and strengths—of Soviet schools are unique to their unwieldy system of central control, they face some problems American schools do: shortage of qualified teachers, lack of facilities (especially in nonurban schools) and fast-growing enrollment.

The author points out one problem that may become much more serious for Soviet planners: overproduction of ten-year-school graduates aspiring to go on to college. An already pressing problem is to reconcile the frustrated visions of those who fail with Soviet economic realities.

Mr. Korol examines many other facets of Soviet science training: selection of students for universities and technical institutes, course content, textbooks, quality of school and teaching facilities.

Of special interest is the chapter concerning graduate training and the conduct of various research projects. A huge amount of research is organized under the USSR Academy of Sciences and its 13 sister academies at the republic level. They form, in the words of one observer, "a gigan-

tic enterprise which has no equal in the world in the scope of its scientific work, versatility of its social functions and the size of its staff."

The book will appeal chiefly to educators, but scientists and engineers will find a lot of absorbing reading.—JBB

The Master Lives On

HEAT TRANSFER, Vol. 2. By Max Jacob, with technical editing by S. P. Kezios. John Wiley & Sons, Inc., New York. 652 pages. $15.

ELEMENTS OF HEAT TRANSFER, 3rd ed. By Max Jacob and George A. Hawkins. John Wiley & Sons, Inc., New York. 317 pages. $6.75.

Between the time we enrolled for Ch. E. 238—Advanced Heat Transfer—and the first meeting of the class, most of us had borrowed copies of "Heat Transmission" by McAdams and/or "Process Heat Transfer" by Kern.

So, it came as quite a financial blow when the prof (visiting from an adjacent engineering school) announced that the text for the course would be "Heat Transfer—Vol. 1 by Max Jacob, pronounced Yahcob. You can buy it at the university bookstore."

You can well imagine that this financial antagonism matured into an academic controversy by the third week of the semester.

"Why in the world did you select this.....book for the course?"

If you are shocked at the impudence of students addressing such a question—and in such language—to an Adjunct Professor, we must quickly explain that this was an evening course in which most of the enrollees were working chemical engineers pursuing graduate degrees on a part-time basis.

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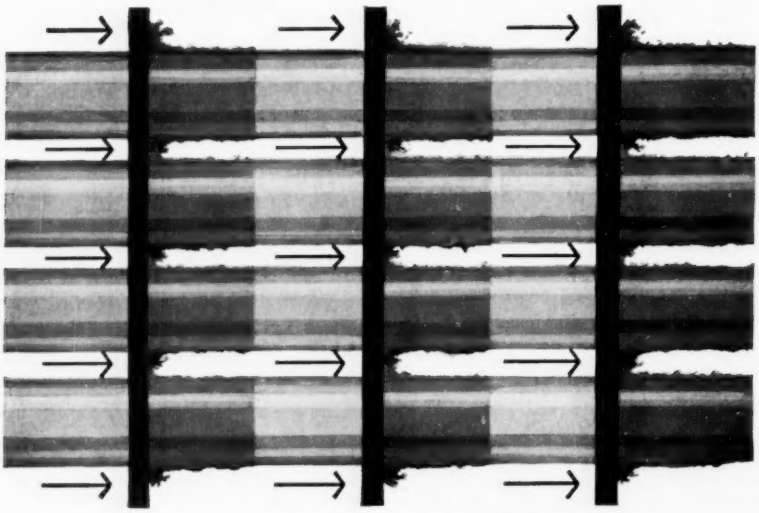

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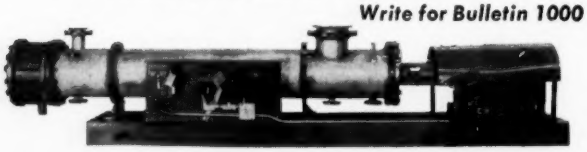

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to and ask about how this problem was solved in the past. What I'm gonna try and do in this course is to make you so smart that when the boss comes over with a heat transfer problem that no other engineer in your office can solve, you'll be able to solve it.

"So the book for this course will be Heat Transfer—Vol. 1 by Max Jacob, pronounced Yahcob. And by the time May rolls around you'll be so thrilled with Vol. 1 that you won't be able to wait until Vol. 2 comes out."

It's been a long time since then. The Adjunct Professor is now Assistant Dean of Engineering at that nearby school and no longer does much heat transfer research. For this reviewer it has been more than five years since he did his last heat transfer calculation.

But I have been actually looking forward to seeing the second volume of this excellent work on theoretical heat transfer. Somehow, we learned to appreciate what was in that book "with all the math equations in it." In fact, most of us were amazed at how much the professor seemed to have learned between February and May.

Unfortunately, the master of heat transfer theory, Max Jacob, passed on before publication of Vol. 2; but fortunately for engineering science, his work on the theory of heat radiation, selected applications, and supplementary material for the convection and conduction theory covered in Vol. 1 were in a state of completion which allowed S. P. Kezios—with the able assistance of Mrs. Anna Jacob—to prepare the manuscripts for final printing.

If there is any fault at all to be found with Jacob's contribution to the literature of heat transfer, it is his compelling desire for completeness. There is just too much information on each subject. It's not the kind of book you go to when you're looking for a quick answer to a practical engineering problem.

But it is the work that the high-powered engineering scientist might turn to first when he had a particularly unsolvable problem in heat transfer to solve.

After all, even Prof. McAdams and Don Kern don't give away

all their secrets in their books.

Naturally, before you can walk, you must first learn to crawl. That's where the new edition of "Elements of Heat Transfer" by Jacob and Hawkins fits in. This is the latest version of the undergraduate text known previously as "Elements of Heat Transfer and Insulation." In the new edition, insulation is played down and heat transfer as an engineering science is emphasized.

We doubt if the average chemical engineer, not specializing in heat transfer as a career, would be willing to spend the effort required to assimilate Jacob's works. However, this kind of approach might be right up the alley of some of our newer engineering science curricula.—RFF

BRIEFLY NOTED

CANADIAN RESOURCES, Part 1. 125 *data sheets. Stanford Research Institute, Menlo Park, Calif.* $10. Gives detailed selected statistics on natural resources, industrial and commercial development of Alberta, British Columbia, Manitoba and Saskatchewan.

METAL CLEANING BIBLIOGRAPHICAL ABSTRACTS, Vol. 3, 1957 Supplement. 44 *pages. Collected and indexed by Jay C. Harris. American Society for Testing Materials,* 1916 *Race St., Philadelphia* 3, *Pa.* $2. Contains over 225 new references including coverage of cleaning by ultrasonic means, cleaning stainless steels and titanium and cleaning semiconductors such as germanium.

NUCLEAR ENGINEERING AND SCIENCE CONFERENCE, 1957 Proceedings. *Edited by Frank Ring, Jr. American Society of Mechanical Engineers,* 29 *W.* 39 *St., New York* 18, *N. Y.* $17.50 *each; three volumes,* $45. Consists of papers pertaining to hot-laboratory operation and equipment.

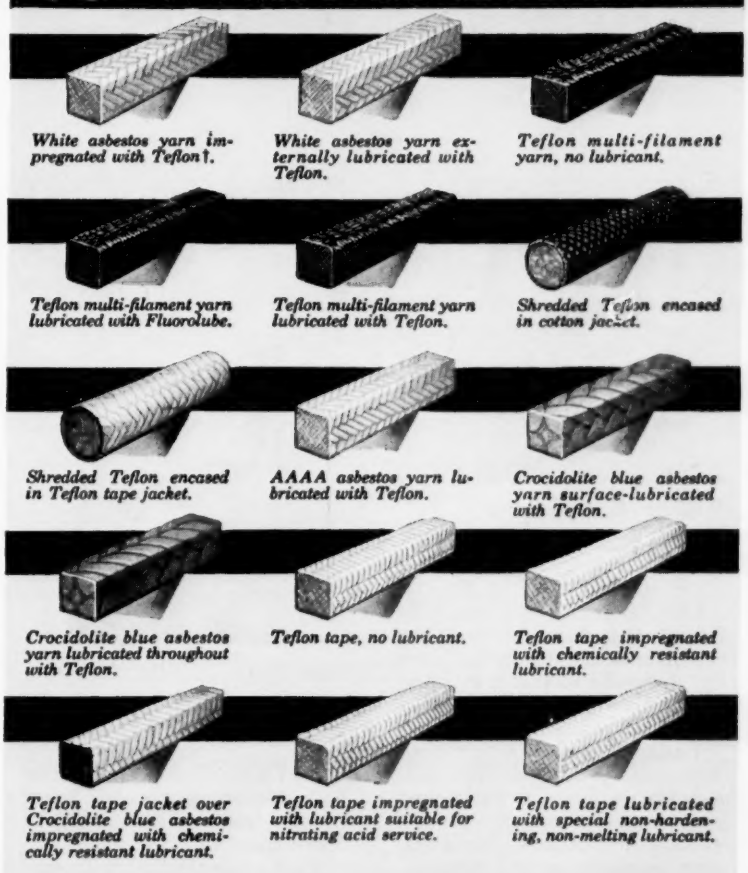
MORE NEW BOOKS

EMULSIONS—THEORY AND PRACTICE. By Paul Becher. Reinhold. $12.50.

PRINCIPLES OF PHYSICAL CHEMISTRY. By Wallace S. Brey, Jr. Appleton-Century-Crofts. $7.

DISLOCATIONS AND MECHANICAL PROPERTIES OF CRYSTALS. By Fisher, Thomson, Johnston and Vreeland. Wiley. $15.

15 SPECIFIC PACKINGS FOR ALL CORROSIVE SERVICES



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M. A. GIBBONS

William E. Ball

SOLVE SECOND ORDER LINEAR EQUATIONS PAGE 145.

Like Co-author Johnson, William E. Ball geared his work for the mathematical series of the CE Refresher so that it could be of the best possible use to the practicing engineer.

Under Johnson's supervision, Ball aimed at whipping the mathematical material—to which most engineers are exposed—for digestion by today's engineers, with emphasis on the formulation and solution of practical applied problems.

Currently, Ball is working on his doctorate in chemical engineering at Washington University. So far he has put in a little over three years of graduate work and expects to get his degree at the end of the fourth.

He earned a B. S. at Washington University in 1952 and taught as an instructor in the chemical engineering department for two years (September 1954, to June 1956).

On top of his heavy schedule at school, Ball works as an applied science representative for IBM. Last year, he also worked as a computer programmer for Socony Mobil Oil Co. And, he gleaned further experience in the field while still in the Army: He spent two years in the Chemical Corps as an engineer engaged in process development work.

Ball is a member of the AIChE as well as the Ass'n of Computing Machinery.

Hobbies and interests include chess, photography, Hi-Fi and archery—especially field archery and hunting.

John Reys

ESTIMATE COST OF GRAPHITE EQUIPMENT. PAGE 137.

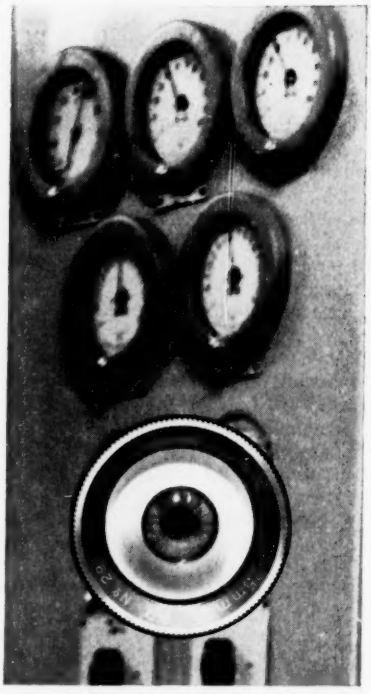
John Reys is chief engineer of Falls Industries, Inc., in Solon, Ohio, as well as a member of the firm's board of directors.

Much of his talents are devoted to the design and development of impervious graphite equipment and components for use in the process industries. Recent accomplishments include the design of the new Cross-bore type heat exchanger and the development of an accepted ASME design code for impervious graphite tube and shell exchangers.

The nature of his job requires a good deal of traveling. Reys is called from all parts of the country to provide technical assistance regarding graphite equipment.

In addition to his pasttime interests of sailing, golf and swimming (for which he claims he doesn't have enough time), Reys is also active in the local group of the Kiwanis International. What's more, he has also served on the construction committee of the club—which has just completed the successful sponsoring of a new $70,000 community swimming pool.

A graduate of the University



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of Michigan, Reys holds a master's degree in chemical engineering. He is a member of the AIChE, the National Ass'n of Corrosion Engineers, and is a registered professional engineer in the State of Ohio.

R. Curtis Johnson

SOLVE SECOND ORDER LINEAR EQUATIONS. PAGE 145.

Both R. C. Johnson and Co-author W. E. Ball are convinced that the real future of the chemical engineering profession lies in more fundamental studies and that the use of advanced mathematics and associated mathematical devices—i.e. computers—will become a prerequisite to the successful practice of engineering.

It is for this reason that they have actively entered into this field themselves. And, it is for this reason that they authored the current series (for the CE Refresher) which concludes with this issue.

This isn't the first time that Author Johnson has contributed to the technical publishing field. In the past, he has authored some fourteen other publications mainly in applied mathematics and in the computer field.

Along with Edwin T. Williams, he will soon chalk up a stoichiometry text—to be published soon by the McGraw-Hill Book Co.

After some ten years of teaching at Penn State and Washington University, Johnson joined the staff of Compumatix, Inc., as director of scientific computation. This new firm is serving the St. Louis area with consulting and service work in mathematical analysis and computing and with business systems and procedures studies.

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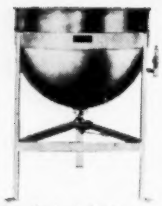

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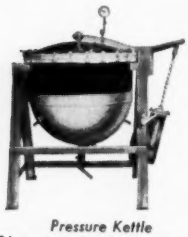

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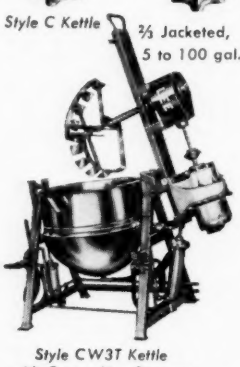

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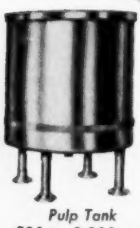

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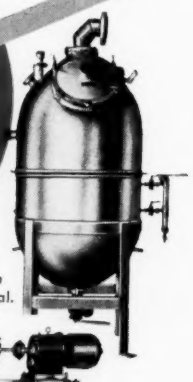

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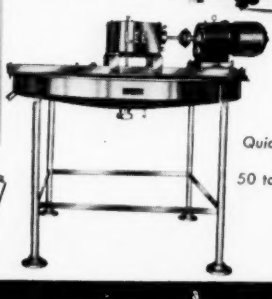

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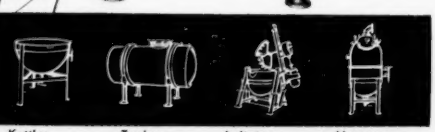

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AUTHORS . . .

O. A. Battista

SIX SURE STEPS TO THE TOP. PAGE 165.

One of our most popular authors returns, this time, to give you a point-by-point rundown on the best means of going about getting ahead in your firm. He is O. A. Battista who lets you in on the "extras" you'll need in your ladder-climbing, over and above a thorough knowledge of your job.

Author Battista is head of the analytical group in the research and development division of American Viscose Corp.'s Marcus Hook, Pa., unit. He has been associated with the same firm since 1940.

When Avisco lets him go home at the end of the day, he usually sets about writing some new contribution for the publishing world. So far, he has authored "How to Enjoy Work and Get More Fun out of Life" (Prentice-Hall, Inc., 1957) and "God's World and You" (Bruce Publishing Co., 1957). A chapter from the former book appeared on an exclusive basis in *Chemical Engineering* (Sept. 1957, p. 321), labeled, "How to Enjoy Work While on the Road." The selection, geared for those who often travel on expense accounts, gave some fine tested travel tips.

Before joining Avisco, Battista had worked with the late Professor Harold Hibbert at the Pulp & Paper Research Institute of Canada, in Montreal.

Battista graduated with honors from McGill University in Montreal, P. Q. There he earned his bachelor of science degree. Some years later, St. Vincent College, in Latrobe, Pa., conferred on him an honorary doctor of science degree.

Thirty-nine-year old Dr. Battista is a native of Cornwall, Ontario. He and his family now live in Drexel Hill, Pa., a suburb of Philadelphia.

Robert Crooks

REVIEW PATENT FUNDAMENTALS. PAGE 121.

Lawyer, engineer, pilot, author —Robert Crooks has had a busy career. And, it's a good record for such a young man.

The current article was written while he was a staff member of Arthur D. Little, Inc., in Cambridge, Mass. Crooks wrote it to serve as a patent manual for use by other staffers.

When he left ADL, he became resident counsel for the McMillan Industrial Corp., in Ipswich, Mass. And before joining the Cambridge firm, he had served as attorney with General Electric and with Kenway, Jenney, Witter & Hildreth—a Boston, Mass., law firm.

Before going before the Bar, Crooks had studied at MIT. He holds S. B. and S. M. degrees in electrical engineering. During World War II, he served as a military pilot.

Crooks earned his degree in law from George Washington University in Washington, D. C. He's now a member of the Bars of the District of Columbia, New York and Massachusetts. He holds membership in Tau Beta Pi, Eta Kappa Nu, the Massachusetts Bar Association and the American Patent Law Association.

Present activities relate to matters of business, engineering, patent law, and general law. But, he tells us, the work which fascinates him most is "doing business" with issued patents.

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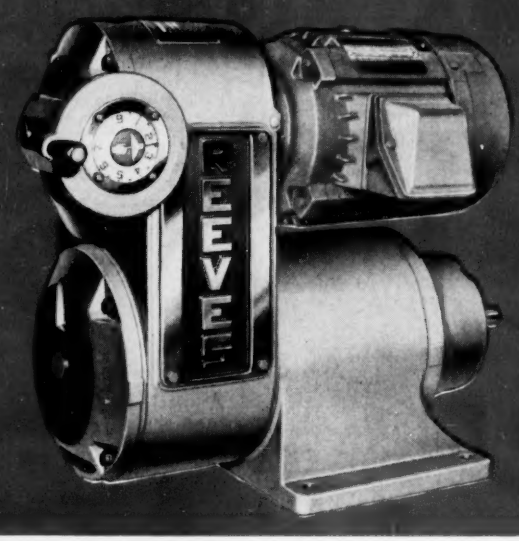

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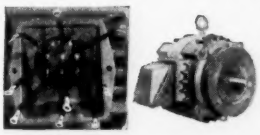

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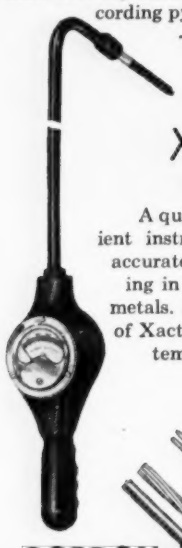

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PEOPLE...

LETTERS: PRO & CON

C. H. CHILTON

JELEN: "Maybe some day I'll have a new subject to write about."

Writing Can Be Fun

Sir:

Here is the manuscript for my final article on cost comparison methods. It is my swan song in this field.

The series has been a lot of fun writing and gave me some rich rewards. I still am frequently asked to talk on this subject and was at Wrightsville Beach twice last year to do so.

But the real fun was in developing a subject to the fullest without the interference of having it a job. It was academic freedom, something all too rare these days, and I want to thank *Chemical Engineering* for the way all the articles were edited.

Maybe some day I'll have a new subject to write about. Just now there are no plans other than to forget it all for a while and let the future take care of itself.

F. C. JELEN

Solvay Process Div.
Syracuse, N. Y.

▶ *We, too, have had a lot of fun with Dr. Jelen's series of articles on capitalized costs and other methods of economic evaluation. And we want to thank Dr. Jelen and his employer for their fine cooperation with our editorial staff.*—ED.

To Make the Weak Strong

Sir:

In my article, "Ion Exchange as a Unit Operation" (Dec. 1957, pp. 255-260), there is one spot where we goofed. On p. 256, first column, we say, "While polyamine functional groups have been used to exchange weakly acidic components." This is not correct, since weakly basic exchangers will remove only strongly acidic components. I believe that we can correct this merely by changing the word "weakly" to "strongly."

F. X. MCGARVEY

Rohm & Haas Co.
Philadelphia, Pa.

On Evaluating Investments

Sir:

Mr. Sandel's article, "Re-evaluate Your Capital Investments" (Nov. 1957, pp. 231-4), was well written. While the approach may

not be new, the methods given for calculation of some of the not-so-obvious costs were of interest.

There was one item, however, which may have been overlooked. Start-up expense, unless it was understood to be an operating expense, appears to have been omitted. Since start-up may involve a cash outlay of some magnitude, it would have been of considerable interest if the author had included details for estimation of this expense.

HAROLD GUSHIN
General Aniline & Film Corp.
Linden, N. J.

Sir:

The article by Morris Sandel on evaluating capital investments is an excellent exposition of the importance of calculating return on the basis of gross investment rather than on project expenditures only. However, there are two points which might be considered debatable.

When allocating existing facilities to a project, use of present replacement value results in an unwarranted penalty against expanding an existing site which was obtained at substantially less than current replacement cost. Allocation of undepreciated book value would be preferable in that it would make it possible for an older plant to compete on a realistic basis for available company funds. Allocating existing facilities on the basis of replacement value would tend to hide from management the greater over-all economy that might be obtained by taking advantage of the lower original cost of existing facilities.

A second debatable point is the practice of taking a tax credit for operating expense included in the project. Basing the return on total project expenditures plus allocations, and including the project operating expense with mill cost, would be more direct. Then when mill cost is subtracted from sales income, the resultant operating earnings will have been reduced by the project operating expense, and when net profit is obtained by deducting federal taxes, the tax credit will be taken care of automatically.

In actual practice the portion of project expense chargeable to operating cost is charged and ab-

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sorbed before the facilities are in operation; hence a further simplification would be to show the return based on total project expenditures plus allocations and neglect the tax credit.

K. C. FINDLAYSON
E. I. du Pont de Nemours & Co.
Edge Moor, Del.

► *If you haven't already read it, you'll want to turn back to Mr. Findlayson's article on the true significance of various cost factors* (*Jan.* 13, 1958, *pp.* 151-4).—ED.

Sir:

Mr. Findlayson's suggestion that existing facilities be allocated at undepreciated book value rather than present replacement cost is valid in periods of inflationary construction costs. However, in deflationary periods, the undepreciated book value would be higher than replacement value. Thus we would have the payoff on a project depending on whether we are in an inflationary or deflationary period, which is not what an evaluation strives to show. By using present replacement costs, this variable is eliminated completely, and each project can be evaluated on more important merits.

Project expense chargeable to operations can either be subtracted from gross investment of the project or can be included in the first year's operating expenses of the new facilities. Either method is acceptable. However, the expense involved must be separately calculated from mill cost, and whether it is subtracted from investment or added to mill cost is a minor consideration.

MORRIS SANDEL, JR.
Reynolds Metals Co.
Richmond, Va.

Pro: Gas Heat Capacities

Sir:

Mr. Wallace R. Gambill has given the engineering profession a real contribution in his articles on gas heat capacities (Sept. 1957, pp. 267-270; Oct. 1957, pp. 283-288).

I am sure that the process engineer welcomes the publication of such useful charts.

R. L. HUNTINGTON
University of Oklahoma
Norman, Okla.

PEOPLE...

NAMES IN THE NEWS

M. A. GIBBONS

With a little bit of luck . . .

. . . and a knack for easy rapport

Man of the Month: Frederick A. Gilbert

President of FMC's Becco Chemical Division is now also top man at Westvaco Chlor-Alkali

Several months ago, when Frederick Gilbert—president of Food Machinery & Chemical's Becco Chemical Division—got home from work and announced that he was now also president of the Westvaco Chlor-Alkali Division, Mrs. Gilbert was a bit taken back. "Fred," she said, "How can you do it? For twenty years you've been telling me that hydrogen peroxide is the only good bleaching agent and now you're going to make and sell chlorine!"

Gilbert plans to do just that and something more. Now, as president of both chemical divisions, it's his job to convince the public that there's an important industrial place for both chlorine and peroxygen chemicals.

And, on top of that, as a member of FMC's four-man operating committee, he'll have a hand in planning the activities of the firm's five chemical divisions.

▶ **How He Got There**—Just how a young man (Gilbert is only 45) manages to chalk up a record like that probably can't be traced to any single factor in his background or experience.

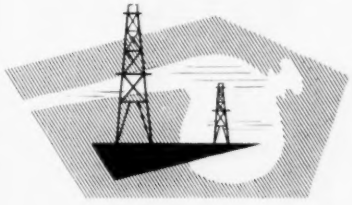
According to the man, himself, though, one big expanation is a considerable amount of luck. It was partly luck that he got into the chemical field—he found it fun and knew relatively little, at the time about its spiraling industrial potential. So, though he chalked up a good record in Latin—straight through Ovid and Virgil—he stuck with chemistry when college-majoring days rolled around.

But the lab side of the chemistry picture never did hold much of his interest. In fact, his last thought on graduation was a job in research. Only one hitch to his plans, though: the year 1934, when he graduated from Harvard, wasn't one in which industry was hard-pressed to find young men for jobs. So, on Feb. 4, 1935, Gilbert found himself tossing test tubes around for the Buffalo Electro-Chemical Co. (Becco's ancestor).

▶ **Off to a Good Start**—Thus, it was his good fortune that he got in with a growing young firm (only nine years old at the time), where the smallness of the operation was a perfect setup for a

FIRST OF ITS KIND

CHEMICAL AND PETROLEUM ENGINEERING EXHIBITION



An outstanding development in British industry in the last twenty years has been the expansion of the Petroleum refining and Chemical Industries. The Chemical and Petroleum Engineering Exhibition—the first of its kind—will present dramatic evidence of the tremendous achievements that have been made.

At Stand after Stand, contractors, designers and specialists in every branch of British chemical and petroleum engineering will have something to show of vital interest.

The Exhibition will also include a conference on "The Organisation of Chemical Engineering Projects" arranged by The Institution of Chemical Engineers and The Institute of Petroleum; and films will show how the Chemical Plant and Petroleum Equipment Industries have helped in the development of their consumer industries.

A visit to this Exhibition is a MUST to all concerned in chemical and petroleum projects and to everyone whose industry is in any way influenced by such projects.

JUNE 18-28 1958
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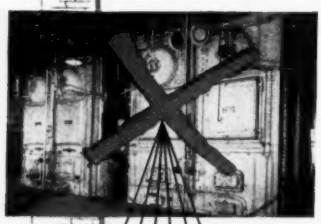
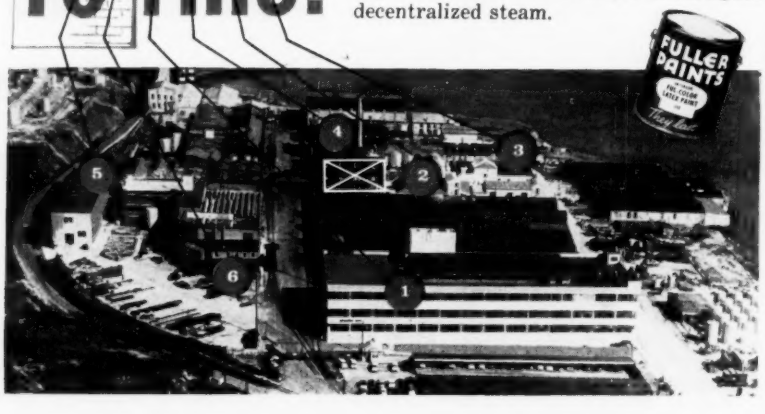


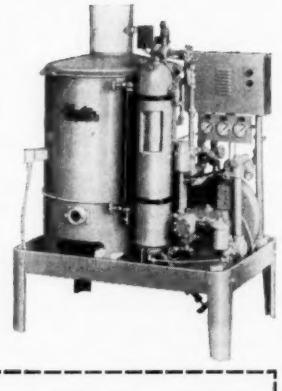
FROM THIS

TO THIS!

When W. P. Fuller was faced with a large boiler repair bill, plus replacement and possible extension of transmission lines, they looked into decentralized steam... using Clayton Steam Generators. Under the proposed Clayton decentralized steam plan, six Claytons replaced the old boiler room... each one located near the *steam job required.* Considerably more usable steam is now produced at less cost! Decentralized steam expensive to install? Not at all! The entire installation expenditure was less than the cost alone of installing new transmission lines! Investigate decentralized steam.



Buying Clayton Steam Generators is just smart business! These steam units produce more steam at less cost in only one-fourth the space occupied by ordinary steam boilers. They cost less to install too... no stacks to erect, no walls to knock out, lower rigging expense and lower hauling costs... and you can put them practically anywhere! The secret of Clayton's higher efficiency is *controlled circulation* and balanced feed, a principle of using a continuous single pass tube... thus, they are more reliable and easier to operate, maintain. From a cold start, Claytons produce steam in 3 minutes... and all day they produce only steam needed—instantaneously. Let a Clayton representative give you the complete facts.



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young man just starting out. The company had tremendous spirit —he could see it even then—and it didn't take long for that spirit to infect a young man in search of a career.

Some years later, Gilbert says, somebody finally realized that he would never make a good research chemist and promptly transferred him into production. Luck again—for not long after, because of his background in research and production, he became assistant to the vice president of Becco — Dr. M. E. Bretschger. Eventually, in 1953 to be exact, he succeeded his former boss and the presidency of Becco was handed over to him in May 1956.

▶ **More Than Luck**—Of course, there are other reasons, why Gilbert is where he is today.

A man in his position has to have a real knack for easy, across-the-table contact with people. And, co-workers say it's no chore for him to establish a quick rapport with subordinates.

They say, too, that he has a top-flight record of fine relations with the local labor union in Buffalo. Off-the-cuff comments made by union officials rate him pretty high—despite occasional conflicts of interest.

▶ **Strike a Balance**—How do men like Gilbert keep up with their jobs? In Gilbert's case, one good reason for his success is his ability to relax completely whenever he gets the chance. Usually tries to leave the work in the office—where it belongs most of the time—so that the end of the day brings a complete change.

After hours, he occasionally puts in some time to further a community interest. In the past, he has acted as industrial chairman for the United Fund and as a member of the board of trustees for his pet charity—the Children's Aid.

He goes in for sports too. Tall, slim, energetic—Gilbert looks much younger than his 45 years. But if you ask him about his tennis game, he'll beg off with an "I'm too old for that now" comment.

Besides, since his move from Buffalo to Darien, Conn., (on Long Island Sound) he's too busy boat shopping to look for tennis courts. (Anybody got a yawl for

sale?) Though he has already passed the preliminary charting course, Gilbert confesses that he'll probably have an auxiliary motor on board . . . just in case.

Erich Meyer

L. Sonneborn Sons has announced the appointment of Dr. Erich Meyer as vice president of the firm.

Meyer moves up from the position of director of the department of industrial research, and will continue to be responsible for Sonneborn's industrial research, acting as liaison between research, manufacturing and sales.

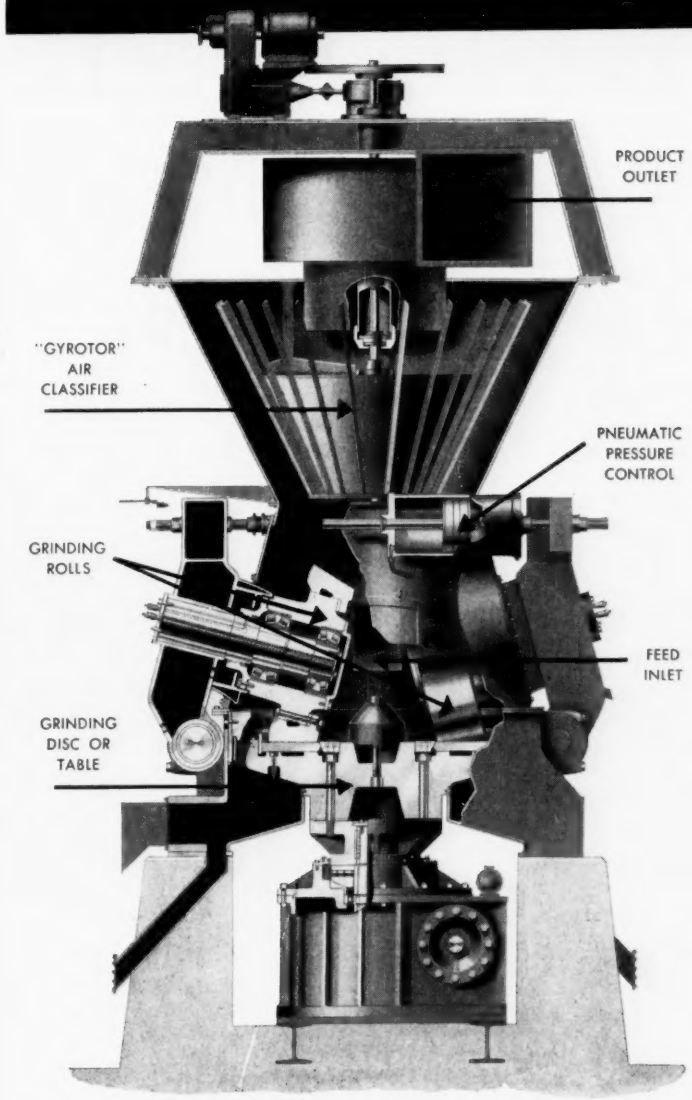
He started with Sonneborn, in 1926, as a chemical engineer. But shortly thereafter, he was made superintendent of manufacture at the company's Petrolia, Pa., refinery. Later, in recognition of the importance of technical knowledge in the sale of its products, Sonneborn made Meyer responsible for its industrial research program from which the present industrial research department developed.

Ralph W. Lohse, recently appointed West Coast manager of Ever-Tite Coupling Co., will be in charge of the firm's new West Coast office at 406 Kress Bldg., 122 West Fifth St., Long Beach 12, Calif.

J. W. LaRocque has been appointed manager of national sales of the Inland Steel Container Co. Division of Inland Steel Co. His headquarters will be in New York City.

S. L. Wang has joined the staff of Tonawanda Engineering

DISC-ROLL MILL



The Hardinge Disc-Roll Mill is a roller-type mill with two adjustable, pneumatically loaded rolls for grinding material on a horizontal rotating disc or table (Loesche type). The Hardinge "Gyrotor" Air Classifier, in combination with the mill, provides a complete grinding, classifying, and drying system. A full description is given in Bulletin 52-11.

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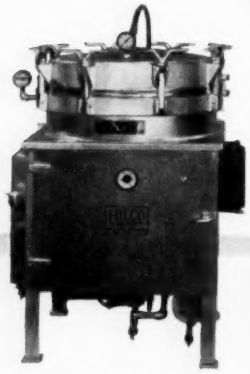

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NAMES . . .

Laboratory of the Linde Co., and is presently working on the application of high speed computers. **Aubrey M. Kirby, Jr.** has also joined the Tonawanda Laboratories, and is working in the process metallurgy section of the research laboratory.

Arthur A. Vernon, chairman of Northeastern University's department of chemistry, has been named dean of Northeastern's new graduate school which will be established July 1.

Wililam T. Griffiths

William T. Griffiths has been elected president of Anders-Lykens Corp., manufacturers of air dryers and gas dehumidifiers. (Anders-Lykens is a wholly owned subsidiary of Milton Roy Co., Philadelphia manufacturers of pumps, analyzers, chemical feed systems.)

An active member of AIChE, Griffiths is an alumnus of Pennsylvania State University. He has presented papers before several technical conferences and has authored many articles on the subject of chemical feed systems.

With offices at Milton Roy's Philadelphia plant in Wyndmoor, Griffiths will continue in has capacity as vice president of marketing for the parent company as well as direct the over-all administration of Anders-Lykens.

Stephen J. Hastings has been appointed manager of the ammonia department, and **Ralston G. Hurlbutt,** supervisor, solid fertilizers, for Shell Chemical Corp., San Francisco. (*Continued*)

ADVERTISEMENT—*This entire page is a paid advertisement* *Prepared by U. S. Industrial Chemicals Co.*

U.S.I. CHEMICAL NEWS

February ★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1958

U.S.I. in New Company to Develop High Energy Fuel

A new company has been formed to carry out process development and semi-pilot plant work on a high energy, boron-based fuel, under Air Force contract. The company, AFN, Inc., is owned one-third each by American Potash, Food Machinery, and the U.S.I. Division of National Distillers.

The combined resources and knowledge of the three participating companies cover almost the entire chemical industry. U.S.I. produces sodium, polyethylene, alcohols, special metals, and a large variety of other chemicals. American Potash makes boron chemicals, lithium, chlorates, perchlorates, and many other products. Food Machinery supplies alkalies, phosphates, peroxygen chemicals, insecticides, among other products.

The initial work will be carried out at Henderson, Nevada.

Ammonia, Sodium Metal Used for Recovering Pure Anhydrous Hydrazine

A solution has been found to the difficult problem of separating ammonium chloride from hydrazine made by the oxidation of ammonia with chlorine. The patented process provides for the addition of metallic sodium in anhydrous ammonia to the mixture of hydrazine, anhydrous ammonia and ammonium chloride.

The sodium reacts with ammonium chloride to produce ammonia, hydrogen and sodium chloride. Since salt is relatively insoluble in liquid ammonia, most of it precipitates out as a solid which can be removed easily by filtration, decantation or other similar means. A solution of hydrazine in liquid ammonia remains, from which pure hydrazine is readily recovered by fractionation.

Yields in the order of 97% have been obtained by adding an amount of sodium exactly equivalent to the chloride ions present. The reaction proceeds at room temperature.

U.S.I. is a producer of metallic sodium and anhydrous ammonia, both of which are used in this process.

Metals Can Now Be Melted While Suspended in Space

A new technique called levitation melting permits researchers to prepare small specimens of metals and alloys with purity levels difficult to reach by ordinary means. The metal or alloy is placed in a high frequency AC electro-magnetic field which causes it to float freely suspended in space, and to melt.

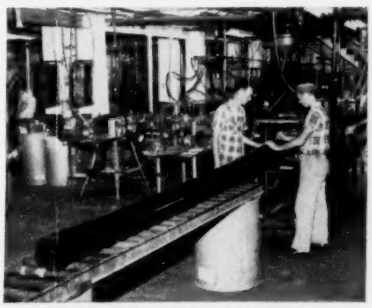
The process uses no containing vessel, and proceeds in an inert atmosphere, eliminating sources of contamination. Melting is achieved in seconds, and electro-magnetic stirring action gives thorough mixing of the melt.

MORE

Longest Polyethylene Pipeline Carries Brine Between Process Plants at Ashtabula, Ohio

Pipe Made of U.S.I. PETROTHENE® Resin Runs for 6,200 Feet From Mallory-Sharon Metals Plant to U.S.I. Sodium Plant

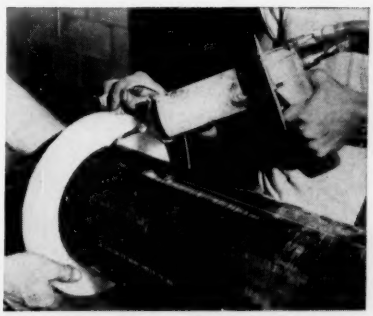
When the problem arose of moving a corrosive solution of saturated brine over 6,200 feet of terrain broken by roads, streams and railroad tracks at Ashtabula, Ohio, U.S.I. decided to use a polyethylene pipeline. Polyethylene was chosen for the job after a thorough study of other materials such as plastic-lined iron, rubber-lined steel and polyvinylchloride. It has the advantages of corrosion resistance, minimum maintenance requirements, ease of fabrication and installation.



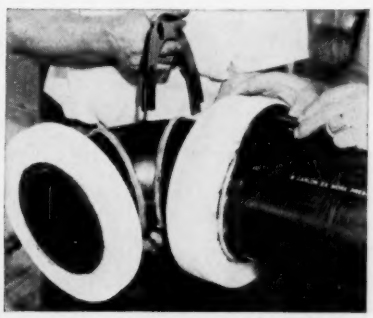
Polyethylene pipe leaving extruder at Carlon Products' Asheville, N. C. plant.

Now in operation, the pipe has an inside diameter of six inches, an outside diameter of 7¼ inches. It is made of U.S.I. PETROTHENE 561 virgin polyethylene compounded with carbon black. The pipe was supplied in 30-foot lengths flanged with polyethylene rings and bolted together at the installation site.

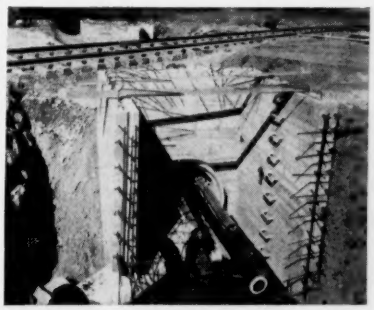
Carrying brine at temperatures ranging from 70 to 90°F, 24 hours a day, 7 days a week, the pipe runs from the brine settling pond at Mallory-Sharon Metals zirconium and titanium sponge plant to the sodium plant of U.S.I.



After cutting pipe into 30-foot sections, polyethylene flanges are hot-gas-welded to pipe.



Steel back-up rings are attached to flanges where elbow meets straight section of pipe.



At site, sections run beneath railroad rest on metal support in reinforced concrete conduit.

After connecting lengths of pipe, line is rolled into trench, needs no further attention.

February ★ **U.S.I. CHEMICAL NEWS** ★ 1958

CONTINUED

Metals Melted In Space

Upon completing the melt, the voltage is lowered, allowing the molten metal to be dropped into a mold. The metal or alloy specimen which results can be used for mechanical testing, metallographic examination, hardness measurements, X-ray diffraction or magnetic studies.

Levitation melting apparatus has been studied at the U.S.I. metals laboratory at Cincinnati, Ohio, for the examination of zirconium, titanium and other special metals.

Levitation melting apparatus in operation. (Photo courtesy Westinghouse Industrial Electronics Department.)

Urethane Foam Can Now Be Sprayed on; It Cuts Insulating Labor Costs

Equipment and techniques for spraying urethane polymer onto overhead, vertical or irregular surfaces, so that it foams and sets in place, have recently been perfected. Insulating coats up to two inches thick can be applied rapidly to vessels, buildings and machinery with no slipping, sagging or falling away of the foam.

In test applications, insulating jobs have been completed in 1/12 the time (calculated in man-hours) required for installing conventional insulating materials. Suppliers of polymer and spray apparatus figure that on ordinary jobs, a trained operator can apply 12 sq. ft. per minute of one inch thick foam.

Since urethane foams are formed by mixing a catalyst with a liquid prepolymer just before application, special spray equipment has been developed which proportions the two materials accurately, and mixes them thoroughly. The polymer formulation itself has been adjusted to meet two opposing types of requirements. It foams and sets rapidly enough to give proper thickness and good adhesion to surfaces. At the same time, it foams and sets slowly enough to avoid clogging of the spray gun.

Flexible and rigid polyurethane foams are produced from the reaction of polyesters with diisocyanates. An intermediate that can be used to produce the polyesters is U.S.I. ISOSEBACIC acid, a mixture of C-10 dibasic acids.

New Decomposition Unit Regenerates Spent Sulfuric At U.S.I. Sunflower Plant

Sulfuric acid regeneration facilities have recently been added to the Sunflower Ordnance plant operated by U.S.I. at Sunflower, Kansas. The new installation converts spent sulfuric acid into sulfur dioxide for use in the plant's oleum and virgin sulfuric acid production process.

Its design capacity is 70 tons of alkylation spent acid per day. The regenerated sulfuric acid is identical to that produced from sulfur.

The unit has no effluent, uses no water and requires only a minimum of outside fuel. Much of the heat is provided by the hydrocarbons in the spent acid, while natural gas and sulfur supply the balance.

With the addition of these new facilities, the Sunflower plant now has a capacity of 250 tons per day on a 100% sulfuric acid basis.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

Chemical literature is described and classified in a 398-page guide now being sold. Kinds of chemical information are analyzed, ways of keeping current are suggested, use of libraries and indexes is discussed. **No. 1321**

New anionic surface active agent is used in the emulsion polymerization of monomers. It is said to act also as a stabilizer for compounding natural and synthetic latices. **No. 1322**

Polyurethane elastomers are described in a new booklet covering physical properties, thermal stability, low temperature behavior, adhesion, carbon black level, peroxide concentration, solvent resistance. Many charts are included. **No. 1323**

To measure the dielectric constant and dissipation factor of insulating materials, a new analyzer has been developed which is direct-reading, non-destructive. It can be used to inspect incoming materials or machine output. **No. 1324**

Two new silicone compounds designed specifically for production of sponge are now on the market. Claimed to form uniform, unicellular sponges which surpass organic sponges in resistance to ozone and weathering. **No. 1325**

An adhesive consisting of a cyanoacrylate monomer modified with thickening agent and plasticizer is now available in limited quantity. Requires no heat, excessive pressure or catalyst for curing, contains no solvent. Said to have remarkable rapid set time and strength. **No. 1326**

More than 4,500 unclassified Atomic Energy Commission research reports are listed in the government's semi-annual price list now available. **No. 1327**

A new wire enamel and a new insulating varnish can be combined in electrical systems to withstand hot spot temperatures of 180 C. At the same time, they can be applied and cured at conventional temperatures of about 150 C. Both are polyester-type materials. **No. 1328**

Methallyl alcohol (2-methyl-2-propene-1-ol) can now be obtained in research quantities. It acts as intermediate for methallyl derivatives, can take part in polymerizations. Suggested uses: synthesis of adhesives, resins, rubber. **No. 1329**

Properties of heat resistant, cast high alloys have been compiled in a set of 14 data sheets. Information is complete, up-to-date, includes room- and high-temperature properties, uses, design and fabrication features, structure. **No. 1330**

PRODUCTS OF U.S.I.

POLYETHYLENE RESINS:

PETROTHENE® 200 Series — high quality resins for extrusion, injection and compression molding, film extrusion, paper coating, blow molding.

PETROTHENE 300 Series — special resins for electrical insulation use.

PETROTHENE 560 Series — black, compounded resins for pipe and mulch-film extrusion.

OTHER PRODUCTS:

Alcohols: Ethyl (pure and all denatured formulas); Proprietary Denatured Alcohol Solvents SOLOX®, FILMEX®, ANSOL® M, ANSOL PR.

Organic Solvents and Intermediates: Normal Butyl Alcohol, Amyl Alcohol, Fusel Oil, Ethyl Acetate, Normal Butyl Acetate, Diethyl Carbonate, DIATOL®, Diethyl Oxalate, Ethyl Ether, Acetone, Acetoacetanilide, Acetoacet-Ortho-Chloranilide, Acetoacet-Ortho-Toluidide, Ethyl Acetoacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl Sodium Oxalacetate, Sodium Ethylate, ISOSEBACIC® Acid, Sebacic Acid, Urethan U.S.P. (Ethyl Carbamate), Riboflavin U.S.P.

Pharmaceutical Products: DL-Methionine, N-Acetyl-DL-Methionine, Urethan USP, Riboflavin USP, Intermediates.

Heavy Chemicals: Anhydrous Ammonia, Ammonium Nitrate, Nitric Acid, Nitrogen Fertilizer Solutions, Phosphatic Fertilizer Solution, Sulfuric Acid, Caustic Soda, Chlorine, Metallic Sodium, Sodium Peroxide, Sodium Sulfite, Sodium Sulfate.

Reactive Metals, Oxides and Salts: Zirconium, Zirconium Oxide, Zirconium Tetrachloride, Titanium, Hafnium, Hafnium Oxide, Hafnium Tetrachloride.

Development Chemicals: Ethylaluminum Sesquichloride, Methylaluminum Sesquichloride, Monomethyl Hydrazine, Triethyl Aluminum, Trimethyl Aluminum, Unsymmetrical Dimethyl Hydrazine.

Animal Feed Products: Antibiotic Feed Supplements, BHT Products (Antioxidant), Calcium Pantothenate, Choline Chloride, CURBAY B-G®, Special Liquid CURBAY, VACATONE®, Menadione (Vitamin K_3), DL-Methionine, MOREA®, Niacin USP, Riboflavin Products, Special Mixes, U.S.I. Permadry, Vitamin B_{12} Feed Supplements, Vitamin D_3, Vitamin E Products, Vitamin E and BHT Products.

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Division of National Distillers and Chemical Corporation
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NAMES . . .

John R. Bowman, director of research at Mellon Institute since 1954, has been appointed associate dean of the Northwestern University Technological Institute and professor of science engineering.

Rolland O. Baum

Election of Rolland O. Baum to a newly created post, that of executive vice president and general manager, has been announced by Tennessee Products & Chemical Corp. In this new position, Baum will be directly responsible under the company president for over-all company operations.

Prior to his promotion, Baum served as executive vice president for procurement of Merritt-Chapman & Scott, the parent company of Tennessee Products. And before that, he had been with Tampa Shipbuilding Co., Tampa, Fla.; Gulf States Fibre Co., Cleveland, Ohio; and Gulf States' successor organization, Tampa Moss & Fibre Co., Tampa, Fla.

Fred W. Elliott has been elected a vice president of H. K. Porter Co. He previously had been assistant to the president.

Chien Liu, Edgar G. Carson and **Frank J. Henglein** have joined the engineering and design staff of Scientific Design Co.

Arthur L. Olender has joined Speer Carbon Division of Speer Carbon Co. as a development engineer.

R. J. Southwell, president of Canadian Resins and Chemicals Ltd., has been appointed

NEW VERTICAL LEAF FILTER

permits use of any filter medium—
minimum hold-up of liquid
no danger of overloading

The Shriver Vertical Leaf Filter—a new concept in enclosed, pressure filtration equipment—overcomes the limitation on usable filter media and eliminates difficulties in cleaning, if the filter is overloaded.

1—When operated with frames, the Shriver Filter can be used with any paper or other filter medium available in sheet form. Cake of any desired thickness can be built up.

2—When used as a precoat filter, the fact that the leaves can be easily separated, makes it unnecessary to provide excessive leaf spacing to prevent damage from overloading. There is minimum hold-up of unfiltered material.

3—Leaf spacing may be easily changed; ready conversion from top to bottom feed (or vice versa); no pipe connections to break when cleaning.

4—Now available in steel or stainless steel construction for total filtering area to 500 sq. ft., for filtering pressures to 80 psi. Larger sizes to specifications.

Leaves with filter paper; frames can be of any desired thickness for cake recovery.

Leaf arrangement for precoat filtration; leaf spacing may be reduced to minimum.

Inquiries invited

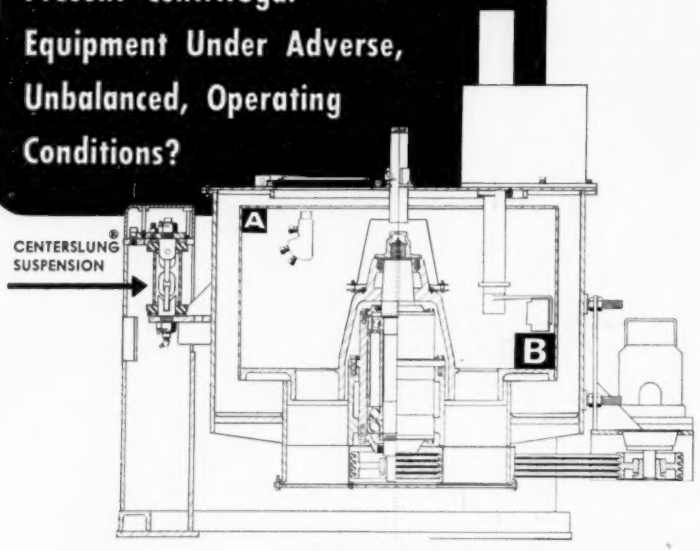
T. SHRIVER & COMPANY, INC.

802 HAMILTON STREET • HARRISON, N. J.

SALES REPRESENTATIVES IN: Decatur, Ga.—Houston, Tex.—Livonia, Mich.—St. Louis, Mo. San Francisco, Cal.—Montreal, Que.—Toronto, Ont.

FILTER PRESSES • VERTICAL LEAF FILTERS • FILTER MEDIA
HORIZONTAL PLATE FILTERS • CONTINUOUS THICKENERS
SLAB FORMERS • DIAPHRAGM PUMPS • ELECTROLYTIC CELLS

How Stable Is Your Present Centrifugal Equipment Under Adverse, Unbalanced, Operating Conditions?



Section of new Tolhurst Batch-O-Matic® combining for the *first time* Centerslung® suspension with bottom discharge, PLUS fully timer-controlled automatic batch programming.

Will your centrifugal equipment operate safely —

A WITH A DYNAMIC OUT-OF-BALANCE LOAD?
(Up to 5 lbs. out of balance at "A")

B WITH A STATIC OUT-OF-BALANCE LOAD?
(Up to 20 lbs. out of balance at "B")

The new Tolhurst Batch-O-Matic Centrifugal passed these tests with no appreciable vibration being transmitted to the foundation — only a smooth oscillation on a horizontal plane and no vertical jumping. That's real assurance of Tolhurst's stability in handling all materials, free or slow-draining, even the toughest jobs. This big operating advantage is provided by exclusive Centerslung mounting — the highly stable suspension that minimizes bearing wear, downtime and other maintenance problems resulting from excessive vibration.

For help in connection with your centrifuging problems, call in your nearest Tolhurst representative. (He is listed in Chemical Engineering Catalog.) Or, write us direct.

Tolhurst CENTRIFUGALS
A DIVISION OF
American Machine and Metals, Inc.
Specialists in liquid-solids separation
Dept. CET-258, East Moline, Illinois

NAMES . . .

a vice president of both Carbide Chemicals Co. and Bakelite Co. Both companies are divisions of Union Carbide Canada, Ltd. **R. S. Jane,** president of Shawinigan Chemicals Ltd, replaces Southwell as president of Canadian Resins.

R. E. Reitmeier

R. E. Reitmeier, one of the founders of Catalysts and Chemicals, Louisville, Ky., has been named president of that firm.

A recognized authority on industrial catalyst technology, Reitmeier has—for the past 20 years—been engaged in the application and use of catalysts in the chemical industry for synthesis gas generation and purification, hydrogenation, desulfurization, as well as in phases of various government and A. E. C. projects.

He has also been active as a consultant on process design and operation for numerous chemical and petrochemical plants.

Donald L. Katz, chairman of the department of chemical and metallurgical engineering at the University of Michigan, was named 1958 vice president of the American Institute of Chemical Engineers.

William M. Langdon has been advanced to senior engineer in the chemistry and chemical engineering department at Armour Research Foundation, Chicago. Langdon is a specialist in the development and design of chemical processes.

George G. Lamb, professor of chemical engineering at the

Northwestern University Technological Institute, is one of five American educators selected to supervise establishment of an engineering school at Godjah Mada University in Java.

W. J. Goodrum of Spencer Kellogg & Sons, has been appointed senior chemical engineer in the research division, Buffalo, N. Y., after nine years in the production division.

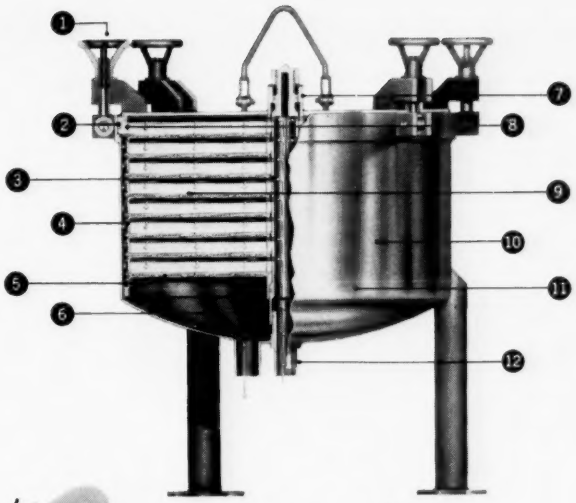
Bert S. Taylor

Bert S. Taylor, vice president of FMC organic chemicals division of Food Machinery and Chemical Corp., has been named director of marketing and purchasing. He will be responsible for all sales and purchasing activities for the FMC division, making his headquarters in New York City.

Taylor was manager of the development department of Ohio-Apex Chemical Co., on its acquisition by Food Machinery and Chemical in 1951. He continued in this post until 1956, when Ohio-Apex Division became a part of FMC organic chemicals division, and he was named resident manager of the Nitro, Va., plant and vice president of the new division.

Prior to his association with Ohio-Apex, Taylor was factory manager of B. F. Goodrich Co.'s plastics division at Marietta, Ohio. Earlier, he spent several years with Goodrich in Akron, Ohio, working in rubber and plastics manufacturing.

Antoni K. Oppenheim, associate professor of mechanical engineering at the University of California at Berkeley, has



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NIAGARA

OUTMODES ALL OTHER HORIZONTAL PLATE FILTERS

1. Only a few handwheels and eyebolts and one central compression nut seal entire stack.
2. Adjustable O-ring cover gasket provides perfect seal and adapts to different thickness filter media.
3. Uniform feed distribution through plate hubs.
4. Rugged die formed plates will withstand years of hard use — no delicately machined surfaces.
5. Bottom plate reinforced to withstand full differential filtration pressure.
6. Always a clean tank — solids never reach tank.
7. Center compression ring seals plates at center.
8. Compression ring integral with cover seals plates *uniformly* around periphery.
9. Perforated plate or wire screen drainage member for exceptionally high flow rates.
10. All units are ASME CODE constructed for a 75 psig internal pressure.
11. Tank is not normally under any pressure.
12. Central inlet eliminates need for separate scavenger plate.

Get complete details — send for bulletin on Niagara "Batch-Miser" horizontal plate filters today.

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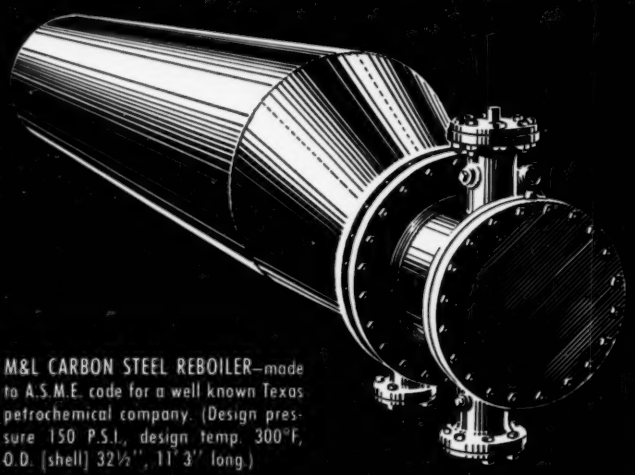
(Niagara Filters Europe: Kwakelpad 28, Alkmaar, Holland)

SPECIALISTS IN LIQUID-SOLIDS SEPARATION

MANNING & LEWIS



M&L CARBON STEEL REBOILER—made to A.S.M.E. code for a well known Texas petrochemical company. (Design pressure 150 P.S.I., design temp. 300°F, O.D. [shell] 32½", 11' 3" long.)

Today's rapid strides in the technology of processing plant operation make it essential for a manufacturer of equipment to be "staffed up" with people who have had extensive training and experience. More than half our staff have spent a major part of their working life in this one field and have played a major role in the design and fabrication of many types of processing equipment. They know the limitations and workability of all metals and how to get maximum service from each. This accumulated knowledge of base materials and our extensive experience in design and fabrication means practical, trouble-free equipment at the lowest possible cost.

It is impossible, in a field requiring such wide diversification, to illustrate, or even list, all the products we have been called upon to supply. The reboiler above is simply one among thousands.

Call on us the next time you need equipment. We are fully qualified to design and fabricate to all codes.

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Dept. A.

DESIGNERS & MANUFACTURERS OF QUALITY HEAT EXCHANGE EQUIPMENT

NAMES . . .

been appointed visiting professor of engineering in the department of chemical and metallurgical engineering at the University of Michigan.

James D. Moore, chief process engineer, has been promoted to production manager of Vitro Uranium Co. He will be responsible for all plant operation, engineering and maintenance and process research and development.

Ernest H. Volwiler, president and general manager of Abbott Laboratories, has won the Priestley Medal of the American Chemical Society for 1958.

John Roach

Hodag Chemical Corp., producer of antifoams and other surface active agents, has appointed John Roach as vice president in charge of production and development.

Roach, a chemical engineering graduate from Illinois Institute of Technology, has been with Hodag since 1954, serving as chief engineer. Before joining Hodag, he served as plant superintendent for Witco Chemical Co., Chicago, and as a plant process engineer for Du Pont in East Chicago and Cleveland.

His new responsibilities as vice president will include the development of new equipment, new plant processes, new products.

L. W. Burdett has been promoted to senior section leader at Union Oil Co. of California's research center, Brea, Calif. and **George Matsuyama** has been appointed a research

associate at the research center.

Warren E. Snyder has been appointed manager of the engineering division of the Midwest Research Institute.

Gordon B. M. Walker has been named division industrial engineer of National Aniline Division, Allied Chemical & Dye Corp.

Stephen E. Malaker has been appointed professor of nuclear engineering at Newark College of Engineering. He will teach both undergraduate and graduate courses, and he will also serve as chairman of a faculty committee to develop a further program of education in nuclear science and engineering to satisfy the needs of graduate students and engineers in industry.

Robert D. Goodall and **H. B. DeVinny** have been appointed vice presidents of Davison Chemical Co. Division of W. R. Grace & Co. Goodall, who has been general manager of petroleum catalysts, becomes vice president and general manager of the chemical division. DeVinny, previously director of industrial and public relations, becomes vice president with the same responsibilities.

Don O. Noel has been named vice president of Metals Disintegrating Co. and will assume administrative duties as operating head of the company. Since joining Metals Disintegrating in 1929, Noel has worked in research, production, sales and engineering.

Edward J. Skiba, vice president, engineering of Brown Fintube Co., has been elected executive vice president and a member of the board of directors. **Douglas W. Towers**, chief thermal engineer, has been made vice president, product engineering.

Frank Edwards has been appointed plant superintendent, ceramics division of Patter-

TO IMPROVE SOLIDS-LIQUID SEPARATION PROCESSES

Consider

MULTI-METAL FILTER MEDIA

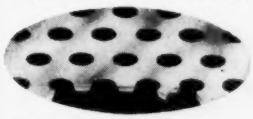
Wire Cloth and Filter Cloth in all alloys, and every degree of density down to 400 mesh and in all weaves.

"Neva-Clog" perforated sheet metal medium functions on edge filtration principle.

"Mykro-Pore" electrodeposited filter medium in pure nickel, with round or slotted holes; wide range of opening sizes, hole patterns, open area ratios and thicknesses.

"Multibraid" (magnified); dense, strong, woven filter cloth.

"Neva-Clog" (magnified to show flow); perforated sheet metal filter medium.

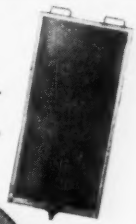


"Mykro-Pore" (magnified cross-section); electrodeposited filter medium.

MULTI-METAL FABRICATIONS

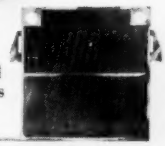
A complete, comprehensive and versatile service in converting filter media into filtration or other processing components or complete units:

Filter leaves for all pressure and vacuum filters; screens for plate and frame presses; tubular filter elements; strainers; vibrating screens; baskets; hoppers; cylinders; elements for dryers, catalyst units, washers, mixers, etc., and complete apparatus or machinery.



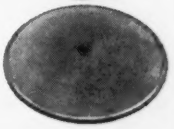
"Rim-Lok" leaf for vertical or horizontal filters.

"Sweetland" filter leaf.

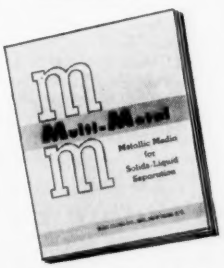


"Multi-Plate" fabricated filter press plate.

Elements for gas stripping process.



Vibrating screen disc.



Catalog 57 gives helpful, practical information on Multi-Metal research, engineering and product services for better methods and means of solids-liquid separation. Write for a free copy.

MULTI-METAL WIRE CLOTH CO., INC.

1353 GARRISON AVENUE • NEW YORK 59, N. Y.

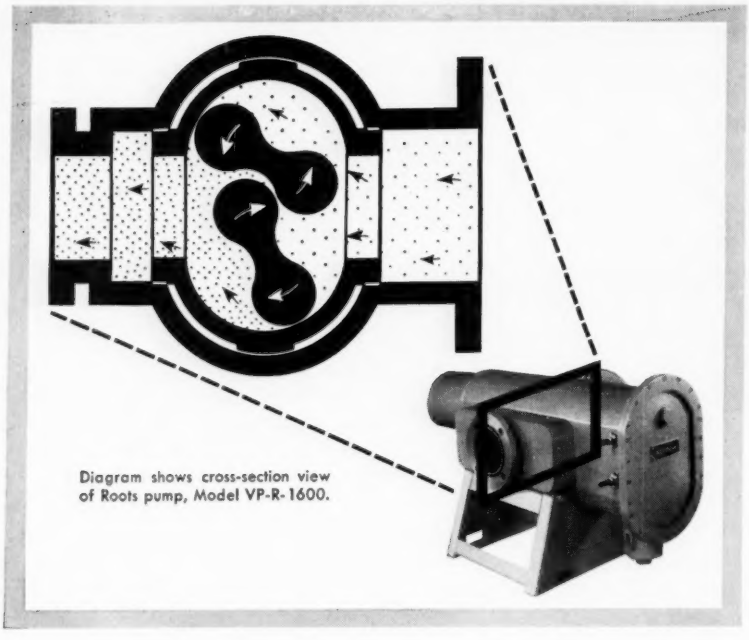


Diagram shows cross-section view of Roots pump, Model VP-R-1600.

How to get vapor-free high vacuum

fast . . . with the ROOTS pump

Now you can achieve completely dry pressure in the 10^{-1} to 10^{-5}mm Hg range using only a *mechanical* high-vacuum pump.

Probably the world's fastest pump in this range, the new Roots pump works without the aid of oil or steam vapors.

A pair of finely machined rotary pistons do the pumping. The pistons never touch one another or the pump casing, so the Roots pump needs no oil sealing. It cannot contaminate a system with backstreaming vapors.

Consider these other advantages:

1. Speed. The model shown above has a throughput of 10,400 micron cu. ft. per minute at 10 microns.

2. No shaft seals, no leaks. Motor operates within the vacuum.

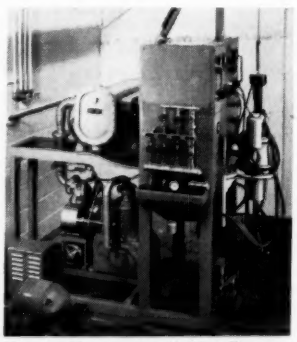
3. No by-pass or valving. Roughing is done directly *through* the pump.

4. Quiet. The Roots pump does not vibrate when in operation.

5. Low power consumption.

Under a license with the manufacturer, Heraeus (Hanau, Germany), CEC is exclusive agent for all seven models of the Roots pump in this country.

For data on performance and theory of operation, write for Bulletin P8-20.



Heraeus Vacuum Arc Melting Furnaces are also available from CEC. Note Roots pump used. Furnace melts "buttons" to ingots. Particularly useful for obtaining pure samples of metals with high melting points. Information in Bulletin P4-28.

Consolidated Electrodynamics

Rochester Division, Rochester 3, N. Y.

formerly Consolidated Vacuum

Sales and Service Offices in Principal Cities

son Foundry and Machine Co., a subsidiary of Ferro Corp.

Ben F. Melucci has been appointed commercial development manager of the industrial chemicals division, American Cyanamid Co.

J. A. Patterson

J. A. Patterson is merging his existing consulting interest, J. A. Patterson Engineering Consultants in Chempro, Inc., a new, Pennsylvania-chartered corporation engaged in general engineering and consulting work —specializing in chemical processes for industry.

A specialist in extractive metallurgy of rarer metals, Patterson has developed 40 patented industrial processes and designs. And he has authored published technical papers based on his design and development work.

Patterson serves on the admissions committee of the AIChE and is a member of several other technical and professional organizations.

He and his associate in Chempro, Carl Labovitz, have their headquarters in the Plaza Building, Pittsburgh, Pa.

J. H. Francis, Jr. has been promoted to senior representative in the Southeastern District office of the Oil Information Committee of the American Petroleum Institute.

T. H. Glynn Michael has been appointed general manager and secretary of the Chemical Institute of Canada. He will also serve as managing editor of the C. I. C. publications

Chemistry in Canada and Canadian Journal of Chemical Engineering.

Melvin J. Astle, professor of organic chemistry at Case Institute of Technology, has been appointed acting dean of the graduate school.

Herman M. Ingle, Jr. has joined the research and development department of Ethyl Corp. at Baton Rouge, La., as a chemical engineer.

Donald W. Gunther, for three years manager of Westinghouse's materials engineering department, has been named manager of the firm's semiconductor department and its manufacturing plant at Youngwood, Pa.

Nicholas M. Trivisonno has joined the B. F. Goodrich research center, Brecksville, Ohio, as a senior technical man.

Lowell H. Milligan, formerly assistant director of research and development, Norton Co., has been appointed associate director of the company's newly reorganized research and development department. **Neil N. Ault** has been appointed assistant of research and development in charge of the refractory section. And Loring Coes, Jr. continues as assistant director of research and development, but will now be in charge of the exploratory research section.

M. Peter Lux has become a project section manager in the engineering department of Monsanto Chemical Co.'s organic chemicals division. **Malcolm C. Lowe, Jr.** has been appointed project manager in the engineering department of Monsanto's inorganic chemicals division.

William Campaigne has been named Southwestern technical service representative in the Pampa, Tex., office of Godfrey L. Cabot.

L. J. Francisco has been appointed assistant general

This man, cleaning a tank-truck interior of alkyd resin deposits, accomplishes

Oakite Interior Tank Cleaning Unit, Model 531. Automatically sprays hot cleaning solution under pressure. Nozzles rotate vertically and horizontally. Rinses after cleaning. Sprays 45 gal/min at 150 lbs. pressure.

18 hours cleaning in 1 hour

At a New England chemical plant, it used to take three men working six hours to clean out each truck tank—two men inside the tank scrubbing, scraping and sloshing, one man astride the dome to watch in case the oxygen tanks gave out. Even at that, a careful inspection was needed to make sure the tank was properly clean.

That's how it *was*. Now, one man equipped with the Oakite 531 Interior Tank Cleaning Unit, using a cleaning solution recommended by the local Oakite representative, does the whole job in one hour flat. A sweet job, too, with the tank interior shining like new.

It's just one of the many ways Oakite methods and materials save time and money in chemical plants . . . and why you may find it well worth your while to call in your local Oakite man. Meanwhile, for details about Oakite tank cleaning equipment and Oakite cleaning methods for the chemical industry, write to Oakite Products, Inc., 16H Rector Street, New York 6, N. Y.

Technical Service Representatives in Principal Cities of U. S. and Canada

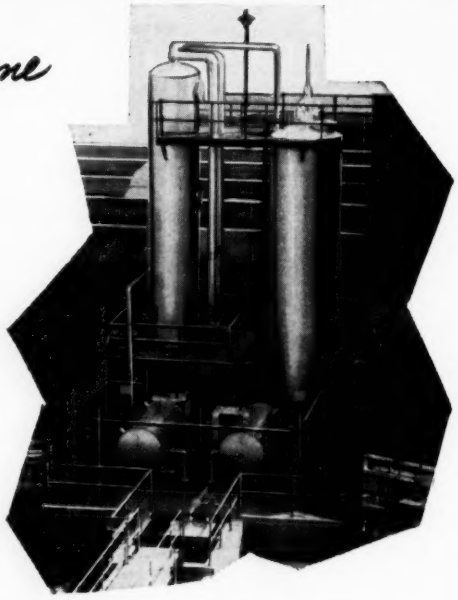
Export Division Cable Address: Oakite

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS · METHODS · SERVICE
SCIENCE

In our 50th year.

WELSBACH Ozone

. . . used by Boeing for oxidation of cyanide wastes



Ozone plant for cyanide oxidation at Boeing Airplane Company's new industrial waste treating plant. In the foreground are the two Welsbach Ozonators.

Application of ozone to the oxidation of cyanide wastes is solving one of the most acute problems in the aircraft and process industries today. Should it be necessary, ozone is capable of producing an effluent of such purity as to permit direct disposal to drinking water supplies.

Rapid expansion of industry has accentuated the acuteness of the problem of toxic waste disposal. The commonly accepted chemical oxidants for cyanide removal, chlorine and hypochlorite, are likely to leave excess chlorine or chlorides in the effluent. These residuals can be as undesirable as the toxic component of the original waste.

Ozone leaves no toxic residual. Its rapid reaction completed, any excess ozone soon reverts to ordinary oxygen.

Ozone's rate of reaction is so rapid that it lends itself readily to continuous treatment, or it may be used on a batch basis in simple holding tanks. Such application provides considerable savings in space and cost compared to chlorination which requires large mixing and detention basins. The elimination of purchasing, freight, storage and handling problems further reduces overall cost.

Welsbach pioneered the development of dependable, long-life ozonators for laboratory and tonnage ozone production. Ozone has many other chemical process applications, and it is more than likely that if you have a process calling for an oxidant, ozone will do the job better and at less cost. Call on Welsbach when you have such a problem.

Welsbach will be glad to send you specific information on the use of ozone in cyanide waste disposal. Write us about your problem today.

Write for this booklet on Welsbach Ozone Generation for Industrial Application. Please indicate company and title.

THE WELSBACH CORPORATION

OZONE PROCESSES DIVISION

DEPT. 603, 15th & WALNUT STS.

PHILADELPHIA 2, PENNSYLVANIA

NAME . . .

manager, plastics and resins division, American Cyanamid Co. He was formerly vice president for sales and advertising of Cyanamid's Formica Corp. subsidiary.

Wayne H. Jens, formerly project engineer for Nuclear Development Corp. of America, White Plains, N. Y., has been named assistant technical director for Atomic Power Development Associates in Detroit.

Lawrence Flett, consultant, National Aniline Division, Allied Chemical & Dye Corp., has been unanimously chosen to receive the 1958 Gold Medal of the American Institute of Chemists.

Woodrow W. Waligore has been appointed to the Odessa branch office of Cooper-Bessemer Corp. where he will serve as sales engineer under the branch manager. Before joining Cooper-Bessemer, Waligore was associated for 10 years with Humble Oil and Refining Co.

OBITUARIES

Leland K. Spink, 58, engineer in charge of flow measurement at Foxboro Co., died December 23 in Foxboro, Mass. He was widely recognized as an authority on flow measurement and a pioneer in calculating and coordinating flow data.

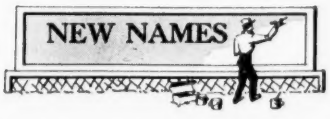
J. E. "Jack" Hanny, 70, a retired vice president in charge of manufacturing for Crown-Zellerbach Corp., died January 3 in Portland, Ore., following a heart attack. He was a company vice president from 1947 until his retirement in 1952.

Willis R. Whitney, dean of industrial research in America, died January 9 at the age of 89. Whitney founded the General Electric research laboratory in 1900 and served as its director for 32 years. He was an honorary vice president of G. E.

PEOPLE...

FIRMS IN THE NEWS

J. B. BACON



Technion Design & Mfg. Co., New York, N. Y., has changed its name to Duramic Products, Inc., to designate company's expanded activity in special ceramic and plastic products.

Borden Chemical Co., Div. of The Borden Co., is new name of the organization formerly called Chemical Div. of The Borden Co.

Harvey Aluminum is the new corporate name of the former Harvey Machine Co., Torrence, Calif.

Minnesota Rubber and Gasket Co.'s new designation is now Minnesota Rubber Co. completing a realignment of company's five subsidiaries.

High Voltage Engineering Corp. has acquired 51% interest in High Voltage Servicing Co., London, Eng., as first step in a program to double overseas installation and service facilities for its Van de Graaff accelerators.

Morningstar, Nichol, Inc. and its industrial adhesives subsidiary, Paisley Products, have merged to form Morningstar-Paisley, Inc.

Union Tank Car Co., having recently acquired assets of Graver Tank & Mfg. Co., announced that Graver Water Conditioning Co. is now a completely integrated and wholly owned division of UTCC.

Lea-Michigan, Inc., has purchased assets of Industrial Lubricants Co. and plans to continue manufacturing Grainlock cements and Drawco drawing compounds.

Industrial Combustion, Inc., has acquired facilities of the former Burner Div. of Cleaver-Brooks Co., Milwaukee, Wis.

American Pulley Co., Philadelphia, Pa., has purchased assets and business of Hubbard Spool Co. and will operate Hubbard as a division of American Pulley.

Fulton Bag & Products Co., newly formed corporation with headquarters in New Orleans, has purchased Fulton Bag & Cotton Mills' plants in New Orleans and St. Louis, Mo.

Haile Mines, Inc., has announced acquisition of National Paint & Manganese Co. of Lynchburg, Va.

Concrete Chemical Products Corp. is now manufacturing and distributing Crete-Prep, a non-alkaline cleaner for such items as concrete, brick, stucco, stone, cement block and ceramic tile.

Eclipse Fuel Engineering Co. is now manufacturing and marketing Seico indicating flowmeters under rights acquired from R. A. Ekstrom & Co.

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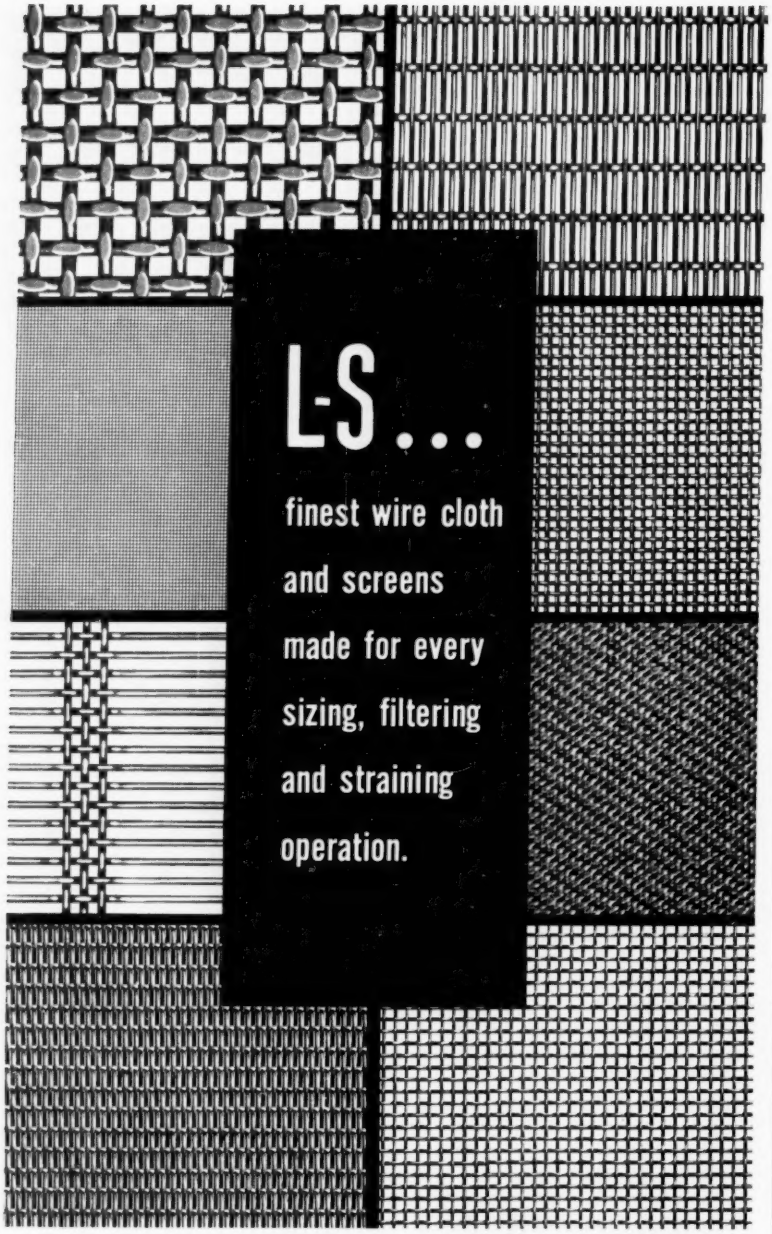

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FIRMS . . .

NEW COMPANIES

Chempro, Inc., with headquarters in Pittsburgh, Pa., has been organized as a general engineering and consulting firm specializing in chemical processes for industry.

Astrodyne, Inc., is being formed jointly by Phillips Petroleum and North American Aviation to unite their activities in field of solid propellants. Headquarters will be at Air Force Plant 66 near McGregor, Tex.

Englehard Industries has been formed by consolidation of nine American companies in the precious metals and precision manufacturing fields. With annual sales over $200 million, new corporation is world's largest fabricator of precious metals.

Rio Tinto-Dow, Ltd., formed jointly by Dow Chemical of Canada and Rio Tinto Mining Co. of Canada, will concentrate on production of thorium and rare earths from by-product material of uranium processing operations in Ontario.

Olin Cuno Filter Corp., formed jointly by Olin Mathieson and Cuno Engineering Corp., will manufacture and sell Micro-Klean filters for overseas markets.

NEW LOCATIONS

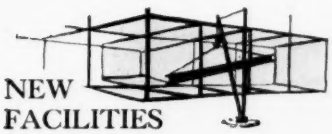
Ever-Tite Coupling Co. has located its new West Coast sales and service office at 406 Kress Bldg., 122 W. Fifth St., Long Beach 12, Calif.

Burgess-Manning Co.'s Industrial Silencer Div. has moved to a new plant located at 9207 Sovereign Row, Dallas 35, Tex.

Petroleum Chemicals, Inc., has relocated its headquarters at 821 Gravier St., New Orleans, La.

NEW REPRESENTATIVES

Automatic Switch Co. has appointed Ju-No Supply Co., Clearwater, Fla., as stocking distributor for Asco solenoid valves.



NEW FACILITIES

Powr-Pak, Inc., aerosol manufacturer, has expanded into a 110,000-sq.-ft. factory in Bridgeport, Conn. Daily production capacity is 350,000 aerosol units.

American Smelting and Refining Co.'s new 100,000-ton/yr. asbestos fiber mill at Black Lake, Que., is scheduled for operation early this year. Asarco is also adding a 22,500-sq.-ft. asbestos research laboratory to facilities at South Plainfield, N. J.

U. S. Steel has installed the eleventh electrostatic aircleaner at its Fairless Works in Morrisville, Pa. The 440,000-cfm. unit was installed by Research-Cottrell.

General Tire & Rubber Co. is building an 85,000-sq.-ft. distribution center in East Rutheford, N. J.

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This 32 page report presents costs and equipment specifications on all the standard impervious graphite processing equipment produced by Falls Industries. Equipment is illustrated with drawings, diagrams or photographs. Costs are tabulated in dollars per square foot of heat transfer surface, or other convenient unit.

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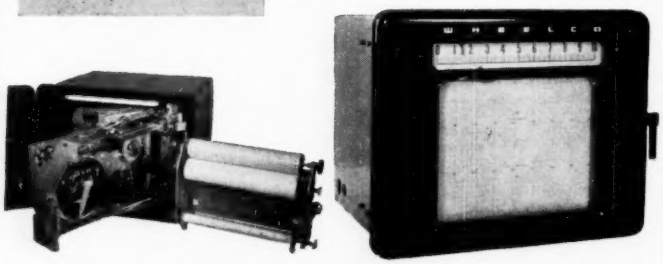

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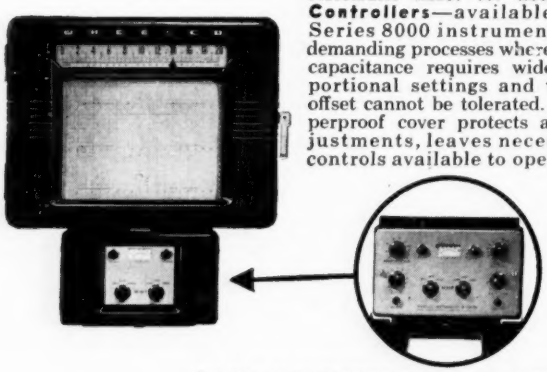

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FIRMS . . .

Hamilton Watch Co. is installing $300,000 worth of additional equipment in a major expansion of its Metal Products Dept. Additions will boost production capacity of its precision metallurgical services.

English Electric Co. has won a $6.2-million contract to supply India with electrical equipment for a fertilizer and heavy-water project at Nagal, India. Plant will turn out 12-15 tons/yr. heavy water and 395,000 tons/yr. nitro-limestone.

Du Bois Co., producer of industrial cleaning compounds and detergents, is erecting a 55,000-sq.-ft. manufacturing and warehousing facility at East Rutheford, N. J.

American Cyanamid is building a product development laboratory and pilot plant at Wallingford, Conn., for its Plastics and Resins Div. Facility, to be completed by late 1958, will house about 70 employees.

Texaco has added a 9,000-bbl./day Platformer at its Lockport, Ill., refinery. A new Unifing unit preheats feed; Texaco also has another Unifining unit under construction to serve No. 1 Platformer at Lockport.

Crown Zellerbach Corp. has acquired a plant at Plymouth, Mich., where its Gaylord Container Div. will manufacture corrugated shipping containers. Plant, after expansion and remodeling, is slated for operation by March 1.

Cornwall Chemicals, Ltd., has just brought a major carbon tetrachloride production unit on stream at Cornwall, Ont. This is firm's initial venture into tetrachloride production; company is major Canadian supplier of carbon bisulfide.

British American Oil Co. is adding a new $4-million catalytic reformer at its Moose Jaw, Sask., refinery. The 5,400-

bbl./day unit will produce high-octane gasoline components. Company also has under construction a 20,000-bbl./day refinery at Port Moody near Vancouver, B. C.

International Synthetic Rubber Co. is erecting a $14-million synthetic rubber plant at Hythe in Hampshire, Eng. Blaw-Knox Co. is principal contractor for the 50,000-ton/yr. unit.

Fischer Scientific Co. will open its ninth plant this September in Philadelphia. Demonstration laboratory, instrument repair shops, order-handling and technical service facilities, and a 33,780-sq.-ft. warehouse will be housed in the brick-and-aluminum structure.

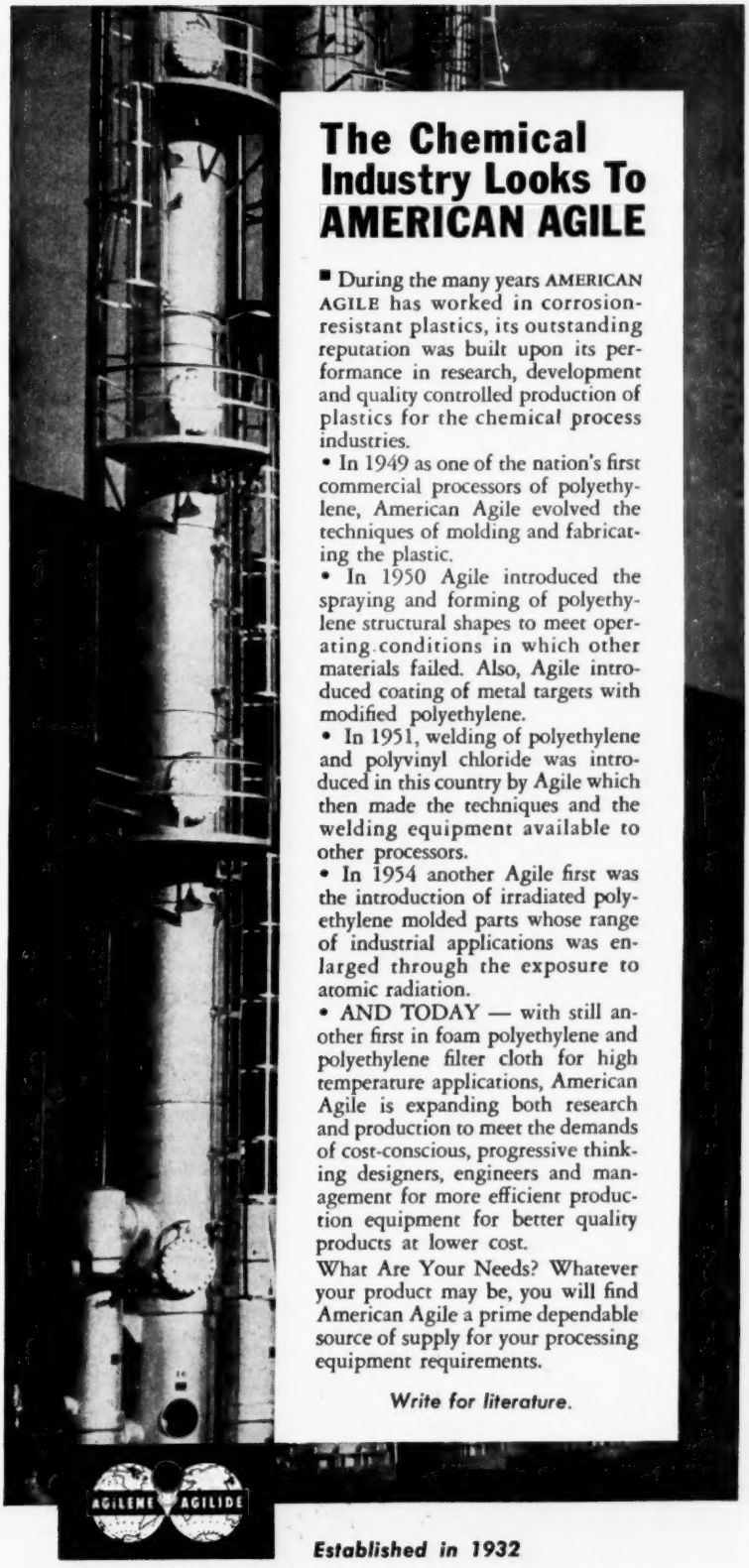
Petroleum Chemicals, Inc., is building a two-story building at Lake Charles, La., that will house the operating and engineering departments. PCI is also engaged in a multimillion-dollar expansion of facilities at Lake Charles.

B. F. Goodrich Chemical Co. is erecting a synthetic rubber plant in Arnhem, Holland, jointly with Algemene Kunstzijde Unie N. V. of Arnhem. When completed in mid-1959, plant products will include butadiene-styrene latex, high-styrene reinforcing polymer and Hycar nitrile latex.

Universal Hoist Co. is adding 12,000 sq. ft. of manufacturing space at its Cedar Falls, Iowa, plant; expands facilities for its bucket elevator.

Francis H. Snyder & Associates has opened a new development laboratory in New Milford, Conn., that will be devoted to finding ways to convert waste wood into usable products.

Colton Chemical Co. has two expansion projects under way: Increased plant capacity at Cleveland for making Flexbound copolymer emulsions and stepped-up facilities at Elkton, Md., for Vinac emulsions.



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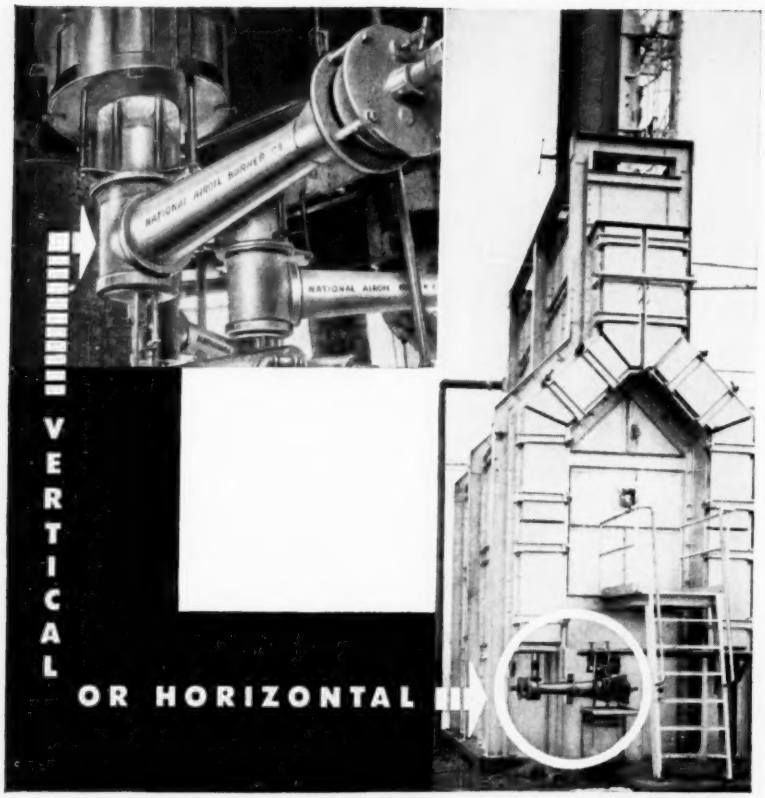

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FIRMS . . .

Hoffman Laboratories has acquired a 22,000-sq.-ft. plant in Hillside, N. J., as part of a general expansion program.

Richardson Co. has started construction on a chemical pilot plant adjacent to its general offices and laboratories in Melrose Park, Ill.

W. R. Grace has opened a 55,000-sq.-ft. laboratory near Clarksville, Md., devoted to inorganic research in field of catalysts, silicas and agricultural chemicals. A second laboratory, to be located on the 150-acre site, will house organic research in polymers, petrochemicals and chemical intermediates.

Dierks Forests, Inc., has started up a $12-million integrated kraft pulp, unbleached paper and liner board mill located in Pine Bluff, Ark. Mill has 150-ton/day capacity.

Wyandotte Chemical Corp.'s new oxide products plant has swung on stream at Wyandotte, Mich. New unit more than doubles company's production of ethylene oxide and proplyene oxide derivatives.

Crown Zellerbach Corp. is studying plans to erect paper-producing facilities in Newfoundland. Plans call for capacity of 400 tons/day newsprint and 2,000 tons/day wood pulp.

Transcontinental Gas Pipe Line Corp. is adding a 75-million-cu.-ft./day gas treating and dehydration plant in McMullen County, Tex. Fluor Corp. is building the $2-million unit.

Allied Chemical has started production at its new sulfuric acid plant in Elizabeth, N. J. Plant features facilities for decomposing and regenerating by-product spent acids.

Air Reduction Pacific Co. has opened its new $7.5-million air liquefaction plant near Los Angeles. Unit produces 75 tons/day liquid oxygen, nitrogen and argon.

Witco Chemical Co. has contracted with Scientific Design Co. for building a 20-million-lb./yr. high-purity phthalic anhydride plant in Chicago. Completion is scheduled for early 1959.

Du Pont is adding three new production units to its Repauno Works, Gibbstown, N. J.: Aniline facility, diphenylamine unit and a new hydrogen-anhydrous ammonia unit. All will be operated by explosives department.

California Portland Cement Co.'s expansion program at Mojave, Calif., is nearly complete. Three kilns, added to plant's original two, up capacity to 17,500 bbl./day cement.

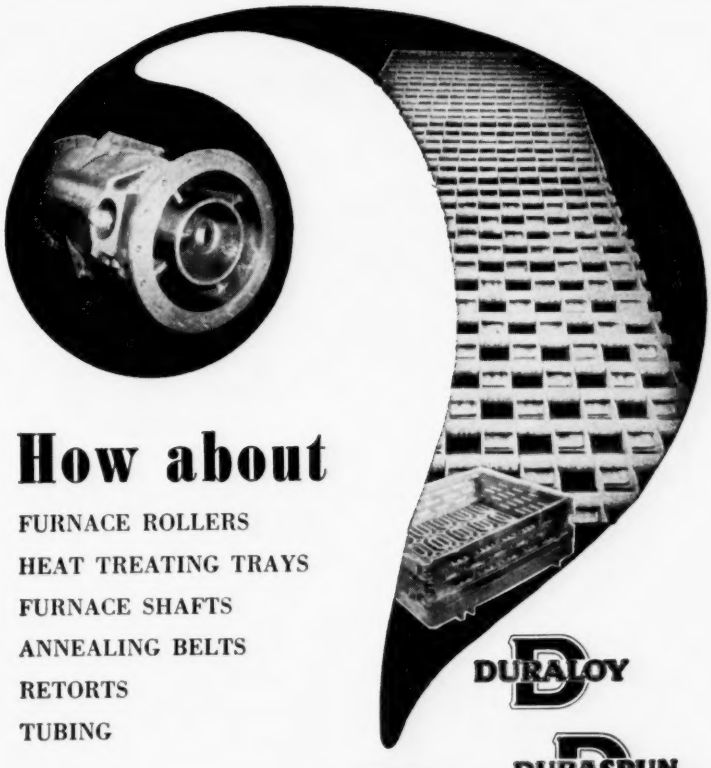
Shell Refining and Marketing Co. is installing a multi-million dollar Udex aromatic extraction unit at its Stanlow, Eng., refinery. Designed by Universal Oil Products, unit will be in operation by mid-1958.

Ferro Chemical Corp. has just completed a $100,000 sales and administration building in Bedford, Ohio.

Atomic Energy Commission will spend $25 million on construction projects at its Hanford, Wash., works during 1958. Projects include $6-million plutonium recycle test reactor, $2-million pilot plant for test reactor program, $3 million for development of a plutonium production reactor and $13 million will go far various plant improvements.

Wah Chang Corp. is slated to start production soon at a Texas City, Tex., tin smelter purchased recently from the government. Remodeling work is almost complete on unit that formerly employed 500 workers.

Carolina Paint & Varnish Co. has added 33,000 sq. ft. to its Greensboro, N. C., plant upping production capacity by 40%.



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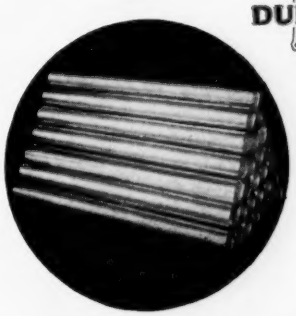

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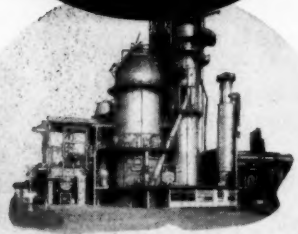

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190 Both items discussed
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- 190b Furnaces

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221Ax Atomic power

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COMPLETE PRODUCT INDEX of chemicals, materials, equipment and services taken from this issue's advertisements and new products departments. You can get more information on any item by circling its code number on one of your Reader Service postcards.

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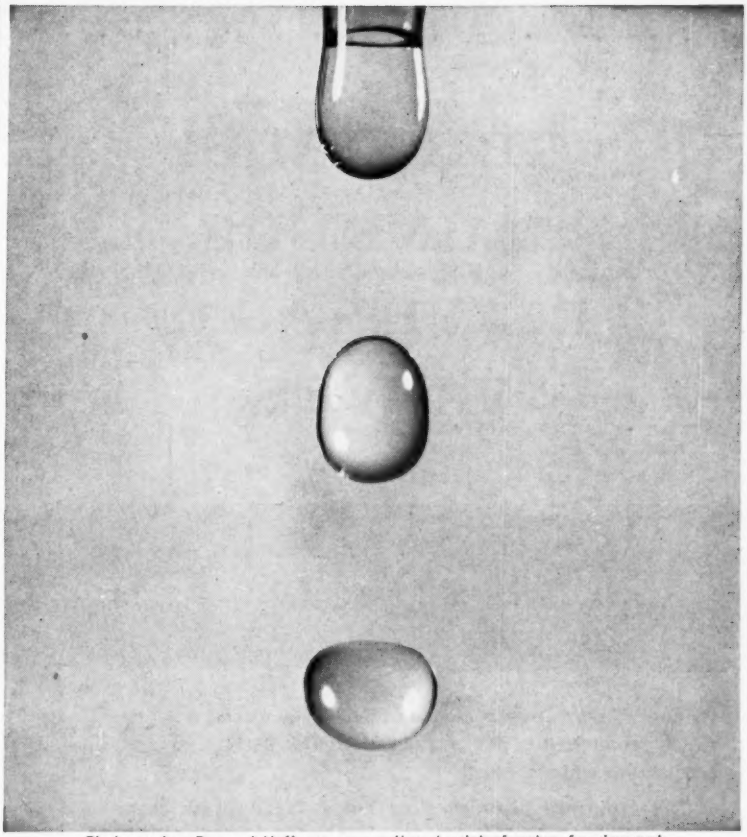

Photographer Bernard Hoffman uses a tiny droplet of water, forming and falling, to illustrate time sequence.

Controlling Time in Fluid Engineering

Even in simple hydrodynamic situations like the one pictured above, time sequence is measured in micro-seconds. More often than not, other factors – such as pressure, volume and flow – all tend to complicate fluid time control. That's where the engineering leadership of S. Morgan Smith can help you most.

SMS Rotovalves, for example, will give you the closest control of closing time . . . as quick as one second or as slow as needed. Their fast initial shut-off limits reversal of flow, and closure is positive and drop-tight. Rotovalves are easier to operate, requiring less power for mechanical or electrical operation, and their full line opening means less head loss and lower pumping costs.

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AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

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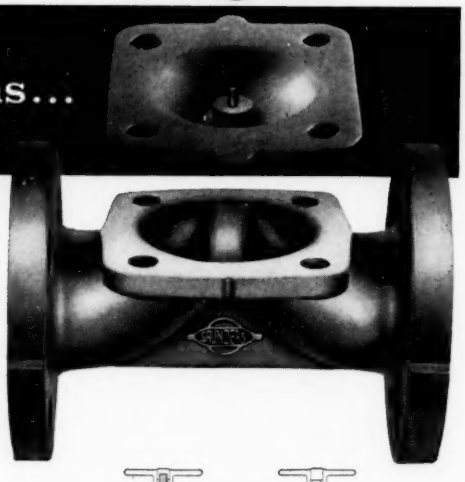
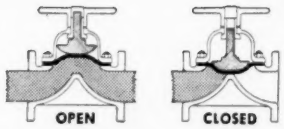


Grinnell Teflon Diaphragms are made by a special process which produces a better product of greater density, toughness and flex life.

The four case histories cited below demonstrate that Teflon offers a very high degree of chemical inertness to some of the most difficult chemicals which industry today must handle. Yet these are only a few of many success stories in the Grinnell files.

Diaphragm life depends on temperature, pressure and frequency of operation. Inquiries must include complete service data to receive prompt and careful attention.

Service Conditions	Saunders Valve Now Used	Service Life: Teflon Diaphragm	Service Life: Previous Valve
Case 1. Benzene hexachloride (30%-40% benzene, free chlorine); 120 to 130 F, 10 to 20 psi; operated 3 to 4 times daily	Glass lined bodies; Teflon Diaphragm; 1 to 3 inches	10 to 14 mos.	1 to 2 mos.
Case 2. 90%-95% HNO_3 plus 1.8% HF (specific gravity 1.62–1.77) 115 F in summer; 40 F in winter; 125 psi; operated 2 to 3 times daily	Durimet 20 body; Teflon Diaphragm; 1 to 3 inches	8 months	2 months
Case 3. $AlCl_3$ complex; ambient to 220 F; 0-50 psi; operated 1 to 2 times daily	Glass lined bodies; Teflon Diaphragms; 1 to 4 inches	9 months	6 months
Case 4. Sulphuric acid 85%; outside temperature; no pressure; operated 4 times daily	Iron bodies; Teflon Diaphragms; 2½ inches	Still in service after 1 year	3 weeks



Features of Grinnell-Saunders Diaphragm Valves

- Diaphragm lifts high for streamline flow in either direction.
- Resilient diaphragm assures positive, leak-tight closure even with grit or scale in the line.
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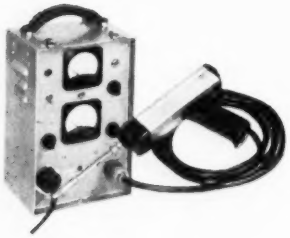

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Chemicals

Adhesive.....An adhesive consisting of a cyanoacrylate monomer modified with thickening agent and plasticizer is available in limited quantity. Said to have rapid set time, strength. TD 1326.
183-4i *U. S. Industrial Chem. Co.

Adsorbents.....4 p. guide and price list of packaged adsorbents for use in chromatographic instruments offers advice on proper selection of adsorbent for class of sample and analysis to be made.
208A Burrell Corp.

Amine, Film-Type.....Hagafilm, a filming type amine, controls corrosion in steam condensate systems, removes iron oxide deposits, increases heat transfer, cuts maintenance and replacement costs.
208B Hagan Chemicals Controls.

Catalysts.....Catalysts are available as tablets, powders, granules, extrusions, spheres and flakes for hydroforming, cyclization, oxidation, dehydration, alkyaltion, etc. Request Book.
108 *Harshaw Chemical Co.

Coatings . . . . . Catalog, "Adhesives, Sealants, Paints and Coatings Listed According to Government Specifications," lists government spec number and title and corresponding company product number.
208C Magic Chemical Co.

Detergents . . . . . Two charts—one, of physical characteristics; the other, of suggested applications—comprise file folder CD-117 on Renex (R) detergents. 14 different compounds are evaluated.
208D Atlas Powder Co.

Detergents, Silicate.....Types of surfaces cleaned of soils most commonly encountered are discussed in "Industrial Cleaning with Metse Detergents." Seven detergents and their applications are described.
208E Philadelphia Quartz Co.

Dysprosium Oxide.....New data sheet lists some physical, chemical and high-temperature properties of dysprosium oxide. Graph illustrates rate of moisture absorption of exide under controlled conditions.
208F Research Chemicals Inc.

Elastomers, Polyurethane . . . . . Polyurethane elastomers are described in booklet covering physical properties, thermal stability, low temperature behavior, adhesion, solvent resistance, etc. TD 1323.
183-4i *U. S. Industrial Chem. Co.

Emulsions, Resin.....Paint handbook contains complete, current collection of technical literature on Flexbond and Vinac emulsions for use as paint vehicles. Includes data sheets, specs, formulations.
208G Colton Chemical Co.

Laminate, Plastic.....Bulletin AD-152 outlines the properties of Kel-F plastic laminate. Discusses acid resistance; zero moisture absorption; heat resistance to 300 F.; antihesive surface.
208H U. S. Gasket Co.

Magnesium Oxide.....Magnesium oxide, in pellet, granular or powdered form, has unusual purity and versatility. Used as an alkali precipitant, furnace feed for refractories, etc. Brochure.
43 *International Min. & Chem.

Methallyl Alcohol.....Methallyl alcohol (2-methyl-2-propene-1-ol) can be obtained in research quantities. Acts as intermediate for methallyl derivatives. For synthesis of resins, etc. TD 1329.
183-4o *U. S. Industrial Chem. Co.

Molding Compounds . . . . . Atlac Thermaflow reinforced polyester molding compounds have high impact strength and unusual electrical and chemical resistance. Properties, applications cited in 40 p. catalog.
208I Atlas Powder Co.

*From advertisement, this issue.

Contents of This Issue

Chemicals and materials. 208
Construction materials... 209
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Instruments and controls.. 215
Mechanical equipment .. 210
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Process equipment 218
Pumps, blowers, compressors 220
Services and Processes... 221

Molding Compounds, Styrene.....Brochure contains comparative properties chart of Catalin's various styrene molding compounds, their formulations and granulations. Includes compounds' applications.
209A Catalin Corp. of America.

Ozone.....Company has pioneered in development of dependable, long-lived ozonators for laboratory and tonnage ozone production. Booklet, "Welsbach Ozone Generation for Industrial Application."
192 *Welsbach Corp.

Pigments, Luminous.....Product of the "Times" color chart includes both Derbylite fluorescent and Paulite phosphorescent pigment colors. Of interest to users of luminescent materials.
209B Luminous Resins Inc.

Quaternary Ammonium Compounds.....Acquats, quaternary ammonium compounds, have been used for their surface active and germicidal properties. Applications include rubber, paint industries.
209C Aceto Chemical Co.

Refractories.....4 p. bulletin covers refractories for petroleum processing needs. Included are data on eight castable refractories, for service to 3,000 F.; refractory brick; bonding mortars and clays.
209D Harbison-Walker Refractories.

Silicone Compounds.....Two new silicone compounds designed specifically for production of sponge are now on the market. Claimed to form uniform, unicellular sponges. Ask about TD 1325.
183-4k *U. S. Industrial Chem. Co.

Solvents.....In surface coating formulations, high-boiling ethyl amyl ketone promotes better flow and gloss, eliminates dry overspray. "Organic Chemicals" catalogs solvents, resins, intermediates.
2 *Shell Chemical Corp.

Stabilizer, Asphalt Emulsion.....Indulin C is low-cost, effective stabilizer in oil-in-water type asphalt road emulsions using resin and fatty acids soaps as primary emulsifiers. Bulletin 101C.
209E West Virginia Pulp & Paper.

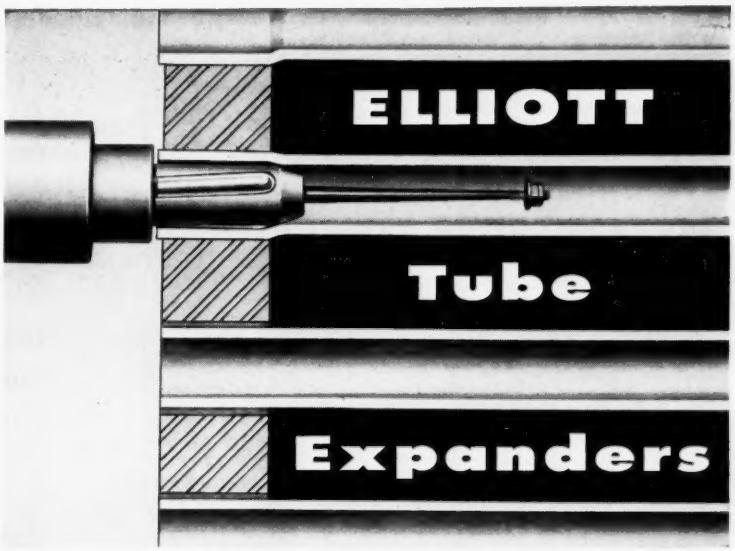
Surface Active Agent.....New anionic surface active agent is used in the emulsion polymerization of monomers. Said to be a stabilizer for compounding natural and synthetic latices. TD 1322.
183-4L *U. S. Industrial Chem. Co.

Construction Materials

Alloys.....Properties of heat resistant, cast high alloys have been compiled in a set of 14 data sheets. Includes room- and high-temperature properties, uses, design features. TD 1330.
183-4 p *U. S. Industrial Chem. Co.

Castings, High Alloy.....Company supplies high alloy castings that are heat resistant, corrosion resistant and abrasion resistant, including furnace rollers, tubing, retorts, etc. Bulletin 3150-G.
199 *Duraloy Co.

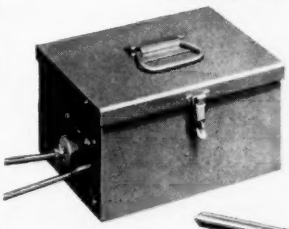
*From advertisement, this issue.



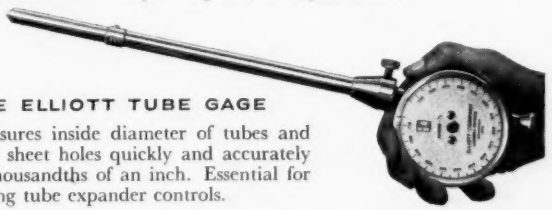
with ELECTRICAL CONTROLS for tight, uniform tube joints

Assures air- or water-tight joint between tube and tube sheet by use of rotating, parallel self-feeding rolls. Elliott expanders have adjustable ball-bearing thrust collars, and rolls having a radius on front and back ends. Available in 4 types, for tubes ¼" through 3", 14 gage.

with ELLIOTT electrical controls, your tube expanding job becomes a precision operation



A *torque limiting device* takes guesswork out of tube rolling. Designed for use with any standard tapping motor, it's compact, easy to operate, and reduces chance of tube failure and tube sheet distortion. *Voltage Balancer* eliminates need for voltage regulator, *Torque Control Knob* assures expanding tube to required size.



THE ELLIOTT TUBE GAGE

Measures inside diameter of tubes and tube sheet holes quickly and accurately in thousandths of an inch. Essential for setting tube expander controls.

Whatever your requirements, Elliott has the tube cleaning, maintenance and expander equipment. Contact your Elliott District Office or write Elliott Company, Lagonda Division, Springfield, Ohio.

Y7-2

ELLIOTT Company
Headquarters for Tube Cleaners and Expanders

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

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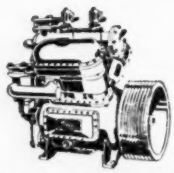
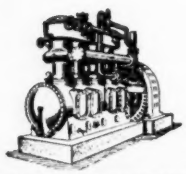
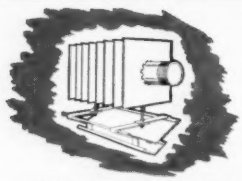


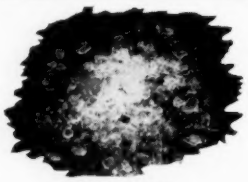
ECLIPSE COMPRESSORS



HEAVY-DUTY COMPRESSORS



PREST FIN PIPE COILS



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VALVES & FITTINGS

Frick Company designs and manufactures equipment engineered to the individual requirements of your plant.

If you need any type of cooling or temperature control . . . call your nearest Frick branch office or distributor for recommendations and estimates.

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Offices in principal cities throughout the world.

"ECLIPSE" COMPRESSORS
2 to 9 cylinders

HEAVY-DUTY COMPRESSORS
3 by 3 to 17¾ by 12

AIR HANDLING UNITS

QUICK FREEZING SYSTEMS

BLOCK & SHELL ICE MAKERS

CONDENSERS
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LOW PRESSURE REFRIGERATION UNITS
¼ to 15 H.P.

CONTROLS, VALVES & FITTINGS

SHELL & TUBE & COIL COOLERS

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA., U.S.A.

LITERATURE . . .

Fabrication.....Company fabricates reactors, pressure vessels, vacuum tanks and the like, sub assemblies and weldments in almost any size or shape. Request booklet, "Facilities and Products".
117 *Newport News Shipbuilding.

Insulation, Hot Pipe.....Features of Z-Crete underground hot pipe insulation include efficient insulation, substantial structural pipe support, resistance to water penetration. Brochure Z-1.
210A Zonolite Co.

Jacket, Pipe.....Gross pipe jacket is designed for heating or cooling pipe. Advantages: easy installation, no welding, high heat transfer rates, low cost, corrosion resistant. Bulletin No. 572.
210B F. R. Gross Co.

Stair Treads.....New, low-cost grating type stair tread of lightweight aluminum is precision cast from an alloy selected for high corrosion resistance and ductility. Abrasive nosing. Booklet.
105 *Aluminum Co. of America.

Steel, Glass-Protected.....Variety of glass coatings for steel withstand different chemical environments, e.g., water, alkalis, organic acids, inorganic acids, high temperatures.
210C A. O. Smith Corp.

Surfacing, Metal.....Kenplate is adaptation of Kennametal cemented tungsten carbide for surfacing metal part to protect against abrasion and wear. Easily applied in shop or field.
210D Kennametal Inc.

Teflon.....Teflon TFE-fluorocarbon resins resist high temperatures and the action of chemical corrosives. Technical properties and many uses, such as faucet seals, are described in literature.
75 *E. I. du Pont de Nemours.

Wire Enamel & Varnish.....New wire enamel and new insulating varnish can be combined in electrical systems to withstand spot temperatures of 180 degrees C. Polyester-type materials. TD 1328.
183-4n *U. S. Industrial Chem. Co.

Wire, Teflon.....Teflon insulated silver-plated copper hookup wire offers exceptional properties for use in aircraft, rocket, missile wiring; transformers; integral and traction motors. Bulletin T-500.
210E Haveg Industries.

Electrical & Mechanical

Bellows.....New bulletin gives operating and construction data on Fluoroflex-T molded Teflon bellows. They offer at least 20 times the flex life and twice the burst strength of ordinary bellows.
49 *Resistoflex Corp

Blades, Cutting.....Brochure No. 3006 contains information on masonry and concrete cutting blades. Diamond, break-resistant and abrasive blades are covered, including small diameter blades.
210F Clipper Mfg. Co.

* From advertisement, this issue

Couplings, Shaft.....Form No. 99 describes semi-floating shaft couplings, used where units are spaced apart and one bearing only is provided for one of the units, e.g. engine-driven generators.
211A Thomas Flexible Coupling Co.

Drives, Variable Speed.....Company's variable speed drives offer unlimited speed range, unmatched accuracy, the ultimate in simplicity and compactness, as well as automated speed control. Cat.
168 *Graham Transmission Inc.

Drives & Motors.....12 p., illustrated booklet, "Sky High to Ocean Blue," discusses specialized drives and motors engineered and built to industrial and government specs by Reliance. Bulletin A-2400.
211B Reliance Electric & Engrg.

Gaskets.....Bulletin AD-104 describes Guardian spiral wound metal gaskets. Details outstanding features and design factors of metal gaskets as well as types available for specific applications.
211C Garlock Packing Co.

Motor-Operator ..... Oil-submerged, spring-return, proportional type electric motor-operator controls dampers in heating, ventilating, air-conditioning systems. In 24, 115, 208, 230 v. Sheet F-8354.
211D Barber-Colman Co.

Motor Drives.....Vari-Speed Motordrive is a complete variable speed power package, which ends high replacement costs in corrosive atmospheres. From ¼ through 5 hp. Bulletin CE34-M578.
175 *Reeves Pulley Co.

Packings, Braided.....There are fifteen field-proved types of Chemlon braided packings, with a type for any combination of service conditions and requirements. Request Bulletin P-325.
171 *Crane Packing Co.

Saddles.....Intalox saddle packings have a higher liquid hold-up than other packings, yet retain low pressure drop characteristics. Bulletin S29-R gives technical data with performance charts.
59 *U. S. Stoneware Co.

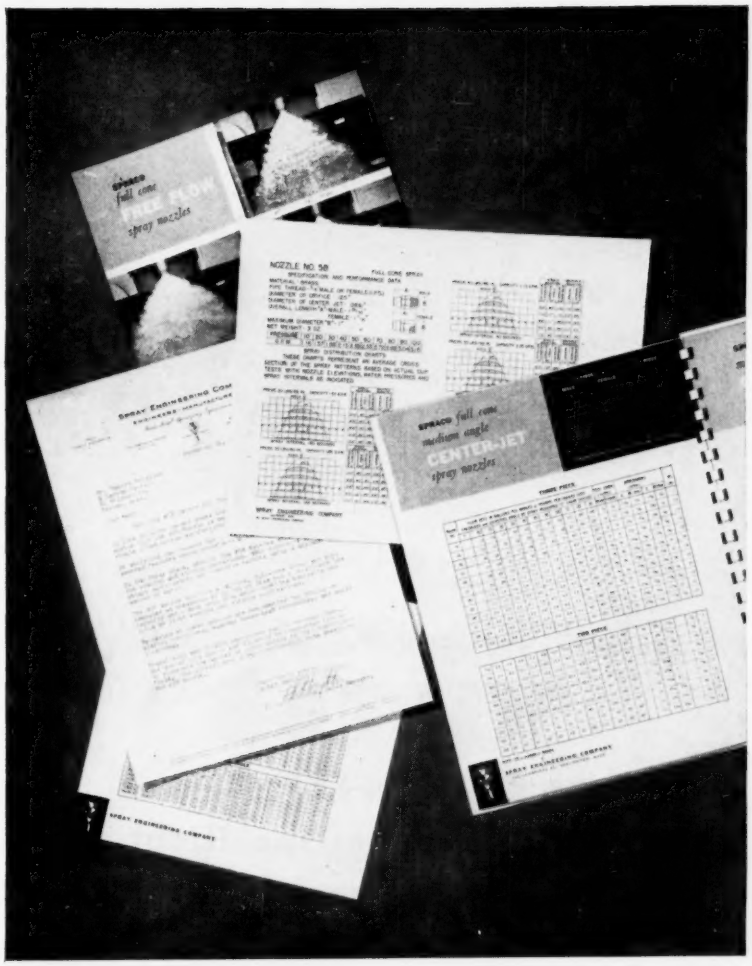
Seals, End Face.....Bulletin EF-100 describes C/R standard end face seals. Specs include ¾ to 4-in. shaft sizes; pressures to 500 psi.; temperatures to 500 F.; peripheral speeds to 15,000 fpm.
211E Chicago Rawhide Mfg. Co.

Silencer, Turbine.....12 p. brochure explains how noise of a gas turbine engine can be effectively silenced. Outlines 10 steps which enable turbine engineer to determine what sound control is needed.
211F Koppers Co.

Handling & Packaging

Bag Closers.....Portable bag closers with tape binding attachments give perfect tape bound closures. The attachment can quickly be removed when tape binding is not required. Catalog File.
193 *Dave Fischbein Co.

* From advertisement, this issue



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Here's a surer, easier way to specify spray nozzles

How can you be sure you're specifying the *right* spray nozzle for your particular application?

Spraco's research department has taken the guesswork out of this problem by preparing complete and accurate performance data for each of the hundreds of spray nozzles in the Spraco line. Each nozzle "profile" is complete with data on material, dimensions, flow rate, pressure, angle of spray . . . everything you need to enable you to choose, at a glance, the nozzle that will deliver maximum performance and efficiency in your particular application.

No matter what your spray nozzle problem, Spraco makes this information available to you absolutely free. Why not write and ask about it — today?

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115 Cambridge Street, Burlington, Mass.

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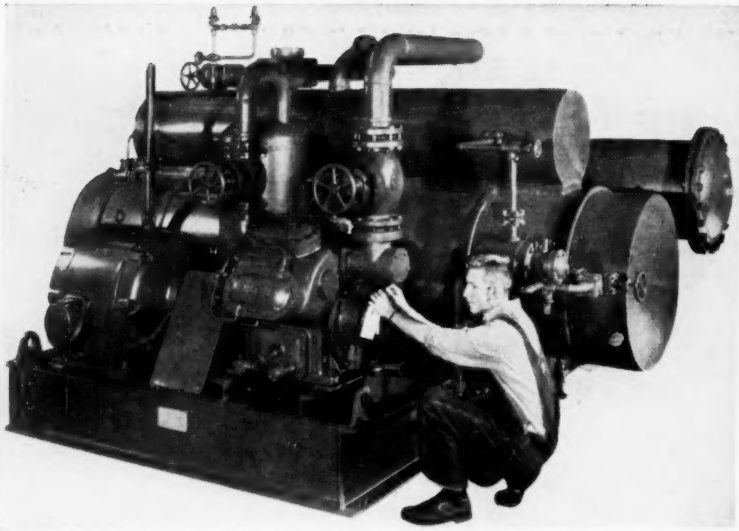


Shown is one of two identical Vilter ethylene glycol chillers factory assembled as a packaged unit for a large chemical company.

NOW, large-size, "packaged"

VILTER

HEAT EXCHANGERS

to meet your exact specifications

The above ethylene glycol chiller built for a large chemical company is factory assembled as a packaged unit. The principal Vilter components include: an 8-cylinder VMC ammonia compressor, 24″ x 14′ ammonia condenser, 12″ x 12′ liquid ammonia receiver, 30″ x 12′ flooded ethylene glycol chiller capable of cooling 405 gpm of 30% ethylene glycol solution from 25°F. to 20°F. The chiller has a 16″ surge drum integrally welded to it. All electrical equipment is installed in explosion proof enclosures. It is typical of the custom work Vilter is doing in the field of heat exchangers and pressure vessels to meet design and budget requirements.

Vilter makes all four basic types of heat exchangers: shell and coil, shell and tube, shell and tube bundle, and atmospheric . . . and in every possible modification. Vilter can give you the most efficient heat exchange equipment with working pressures as high as 10,000 psi. Vilter is equipped to build vessels in conformance to both the A.S.M.E. Code and T.E.M.A. standards.

Today, more than ever before, the leading names in both the chemical and petroleum industries are turning to Vilter for their special vessel needs. Consult with Vilter about your needs.

Write for these helpful bulletins to The Vilter Manufacturing Company
Dept. K-718, 2217 S. First Street, Milwaukee 7, Wisconsin

Bulletin 707
Vilter Condensers
Brine Coolers
Heat Exchangers

Bulletin 427
Vilter Industrial
Heat Exchangers

Vilter®

REFRIGERATION and AIR CONDITIONING

THE VILTER MANUFACTURING COMPANY, Milwaukee 7, Wisconsin

Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water & Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice & Polarflake Ice Machines

Containers.....Lightweight 15½-gallon stainless steel acid containers stack four-high and save shipping costs. They are one of many returnable shipping containers in Hackney Drum & Barrel Cat.
13 *Pressed Steel Tank Co.

Conveyors.....Lo-Veyors are compact, self-contained conveying units that can be suspended from ceilings, along walls, under or at floor levels. Open and closed pan and tubular types. Bul. 39.
T217 *Ajax Flexible Coupling Co.

Conveyors, Vibrating.....Electric and mechanical vibrating conveyors handle anything from lead to feathers, taking care of ounces and tons with equal economy and sureness. Catalog 860-B.
50 *Jeffrey Mfg. Co.

Elevators, Bucket.....Carpco bucket elevators keep belts cool running even when hot materials are being handled. Three sizes; maximum discharge heights of 35, 60 and 80 ft. Bulletin BEB-101.
212A Carpco Mfg. Co.

Tanks, Clad.....Company offers full information on Hortonclad, the new CB&I cladding material that gives an integral and continuous bond of exceptional strength and protective value. Bulletin.
162 *Chicago Bridge & Iron.

Weighing, Tank.....Bulletins 561 and 571, filled with technical data on tank, bin and hopper weighing, the arrangement of cells and instrumentation and the new approach to tank weighing.
79 *A. H. Emery Co.

Heating & Cooling

Combustion Units.....Vertical and horizontal oil-gas tandem combustion units hold air in the combustion zone until fuel and heated air are thoroughly mixed. Send for new Bulletin 498.
198 *National Airoil Burner Co.

Condenser Tubes.....Company offers catalog with complete descriptions of each type of Trufin condenser tube and "Wolverine Trufin Process Flowsheet Book" describing installations where it is used.
33-6 *Wolverine Tube Div.

Coolers.....Catalog No. 557 covers design features, performance and specification data, accessory equipment for horizontal core atmospheric coolers. Discusses Monofin, Monobloc construction.
212B Young Radiator Co.

Furnaces.....Heraeus vacuum arc melting furnaces are available from this company. They are particularly useful for obtaining pure samples of metals with high melting points. Bul. P4-28.
190b *Consol. Electrodynamics.

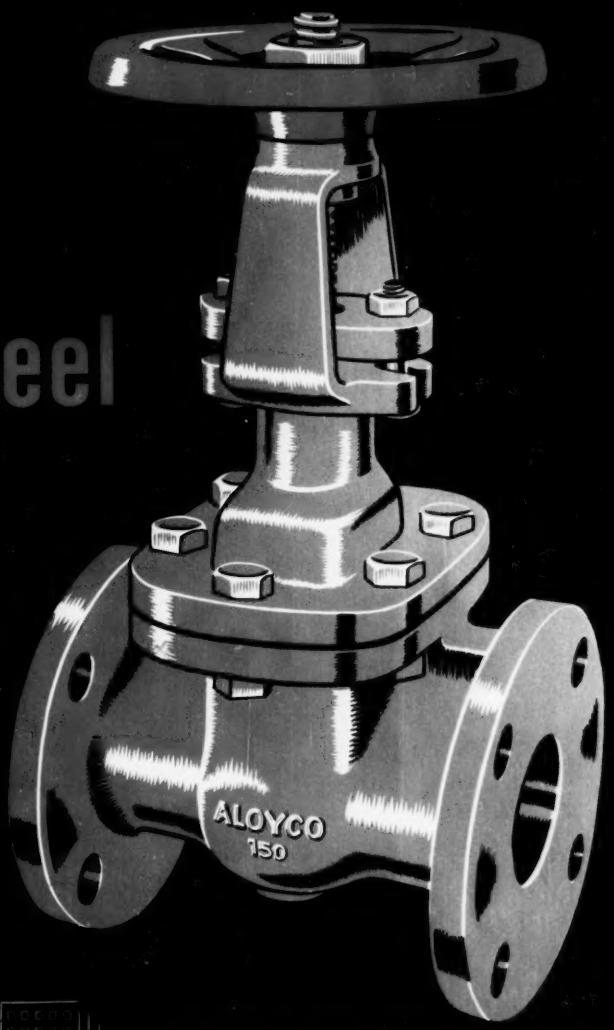
Generator, Steam.....750 hp. standard design steam generator for light and heavy oil and/or gas is of two-pass construction, with centrally located furnace. Design pressure of 200 psi. is obtainable.
212C Cyclotherm.

*From advertisement, this issue

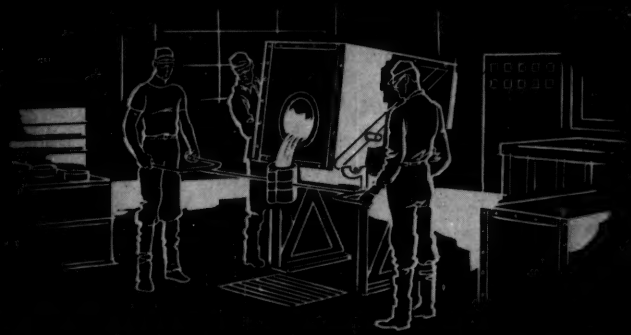
we make

stainless steel valves

...nothing else



ALOYCO 111 Gate Valve for 150 lb. service features double disc ball-and-socket wedges. They are free to rotate and are non-fouling in any position which insures tight closure. There are Aloyco valves and alloys designed for every type of corrosive service.



SPECIALIZATION! Isn't it reasonable to believe that the one company with experience, facilities, research and service all devoted to a single product is your best source of supply? The modern Aloyco foundry, for example, is designed to produce one end product only: pressure-tight Stainless Steel Valve castings of the finest quality.

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Longer Lasting

ALOYCO

VALVES

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Operator in sterile uniform charges stainless steel P-K Twin-Shell Blender with 600 lbs. of dry antibiotic formulation from overhead hopper.

Blender discharges product into chute leading to packaging room below. Absence of internal baffles allows material to flow freely, facilitates cleaning.

Blended antibiotic product is automatically weighed into sterile bulk containers and sealed.

P-K® blending method speeds production of antibiotics at Chas. Pfizer & Co.

When Pfizer Company officials decided that the small, portable blenders in use at their Groton, Connecticut antibiotic plant were bottle-necking production, they drew up this set of standards for replacement equipment: (1) blending of constituents must be thorough and efficient; (2) antibiotic materials must not come in contact with any metal but an alloy stainless steel; (3) the machine for blending the materials must be easily charged and as easily discharged; (4) cleaning must be simple and positive; (5) analysis cost must be reduced through much larger batch sizes.

A 40 cu. ft. P-K "Twin-Shell" Blender met every requirement. Moreover, loading and unloading is just a matter of minutes and clinical cleaning is simplicity itself.

This "Twin-Shell" Blender is one of many P-K types designed for a variety of blending conditions. We urge a pre-test of your formulation in our "Customer Service Laboratory" to determine your exact needs. There is no obligation. For pre-test information, write Patterson-Kelley Co., Inc., 1502 Hanson Street, East Stroudsburg, Pennsylvania.

*Patented

15

Patterson Kelley

Chemical and Process Division

Executive offices and plant: East Stroudsburg, Pa.

P-K Twin-Shell Blenders* • Heat Exchangers • Vacuum Tumbler Dryers • Packaged Pilot Plants • P-K Lever-Lock Doors*

Heat Exchangers.....The 1958 line of BCF heat exchangers has new baffles with flanged lip at each tube hole and around outer edge, new movable stamped steel feet, new sizes. Bulletin 1.1K6.
29 *American-Standard.

Heat Exchangers.....Company offers Bulletin 707, on Vilter condensers, brine coolers and heat exchangers, and Bulletin 427, describing Vilter industrial heat exchangers. Request copies.
212 *Vilter Mfg. Co.

Heat Exchangers.....In addition to fixed bundle shell and tube exchangers, Yates-American now supplies steel and copper shell removable bundle exchangers, fixed bundle aftercoolers, separators.
215A Yates-American.

Heat Exchangers & Chillers.....Self-cleaning heat exchanger eliminates the need to stop processing for cleaning, gives continuous heat transfer. Also vegetable oil chillers. Bul. 1000.
170 *Davis Engrg. Co.

Heat Transfer Units.....Platecoil heat transfer units save on engineering, fabricating, installation, operation and maintenance costs. Double or single embossed, banked or rolled. Manual P61.
26 *Tranter Mfg. Inc.

Ovens.....Forced-convection ovens for research and industrial laboratories eliminate hot and cold pockets, provide precise temperature control, minimize power consumption. Bulletin 34-37-C.
39 *American Instrument Co.

Thermo-Panels.....Company offers free Form DW-6 on thermo-panel coils as drum warmers and coolers, Bulletin 355 with 52 pages of technical data and Bulletin 258 with prices and design data.
BL223 *Dean Products Inc.

Instruments & Controls

Analyzers.....A new direct-reading, non-destructive analyzer has been developed to measure the dielectric constant and dissipation factor of insulating materials. Request information on TD 1324.
183-4 *U. S. Industrial Chem. Co.

Controllers.....Transcope controller, companion instrument to the Transcope Recorder, is ideal for the time constants of modern processing, exceptionally fast and responsive. Bulletin 98278.
16-7a *Taylor Instrument Co.

Detector, Overheat.....8 p. brochure describes continuous fire and overheat detector. Features: pinpoint sensing (alarm temperature independent of length of detector heated); no moving parts.
215B Fenwal Inc.

Flowmeters, Magnetic.....Catalog No. 10D1416 discusses principle and operation of magnetic flowmeters. Also gives advantages and specifications of Fischer & Porter's new units. Request a copy.
215C Fischer & Porter Co.

*From advertisement, this issue

CUNO
Cartridge Filters
• QUICK-OPENING COVERS
• EASY CARTRIDGE CHANGE
• LOW COST • COMPACT
• HIGH FLOW RATES
• LONGEST CARTRIDGE LIFE
• EASY MAINTENANCE
SERIES 1B
1 or 2 Cartridges
SERIES AX
3 to 18 Cartridges
SERIES QS
up to 198 Cartridges
The IDEAL FILTRATION TEAM...
CUNO CARTRIDGES—
a wide range of sizes engineered for optimum efficiency. Graded Density wool and cellulose types and porous metal elements for maximum protection.
CUNO HOUSINGS—
a complete line of standard and special models designed to handle all Cuno Cartridges.
Cuno Filters are filtration engineered for a wide range of requirements from 5 to 75 microns.
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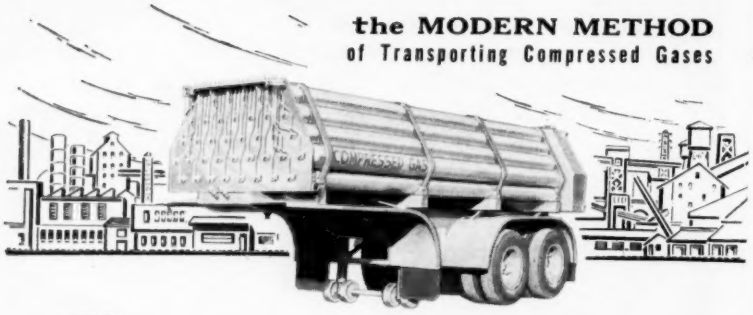
of Transporting Compressed Gases



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tailored just for YOU

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- CAPACITY — to meet YOUR Requirements
- SAFETY — Cylinders, Safety Devices, Controls etc., All in accordance with ICC Requirements for YOUR Protection.
- CHASSIS — by leading Chassis Manufacturers with Service Branches throughout the United States for YOUR Convenience.

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Steelab, top choice of this leading company, was used to fully equip the center's general and special research labs in its huge building in Buffalo, N. Y.

IT'S STEELAB EQUIPPED

Write for Catalogs: "STEELAB" *and* "FUME HOODS"

LABORATORY FURNITURE COMPANY, INC.
171 Old Country Road, Mineola, L. I., N. Y.
Since 1920 . . . Over 50,000 Installations

LITERATURE . . .

Gage, Vacuum.....Type GP-115 single-station Pirani vacuum gage with contact meter measures total pressure of condensable vapors and permanent gases in a vacuum system. Bulletin P9-11.
216A Consolidated Electrodynamics

Gas Chromatographs.....Three sheets on gas chromatographs and accessories include information on low-temperature Beckman GC-1, high-temperature Beckman GC-2, sampling accessories.
216B Beckman Scientific.

Indicator, Water Vapor.....8 p. bulletin 2301 describes Aminco water vapor indicator, instrument measuring water vapor content of compressed gases. Photos, schematics, flow diagrams included.
216C American Instrument Co.

Instruments.....Bulletin Series A-801 covers details of Unitized AutroniC instrument line for indicating, recording and controlling temperature, pressure, level flow, pH. Illustrated.
216D Swarthwout Co.

Ionization Tube.....Bayard - Alpert type vacuum ionization tube, GIC-001, indicates pressures in the 10^{-12} mm. Hg region; has sensitivity of 100 microamperes per micron. Bulletin No. P9-10.
216E Consolidated Electrodynamics.

Meters.....Form 400-S-2 is a form which details all metering variables. It will give the company the information needed to recommend suitable meters for any liquid used in your plant.
109 *Rockwell Mfg. Co.

Meter, Flow.....Positive sealing action plus positive volumetric displacement principle of measurement provide accuracy within ¼ of 1% in meter designed for measurement of slow-flowing liquids.
216F Bowser.

Recorders.....Transcope recorder has control settings on the front of the panel and stays on automatic control when the recorder is removed for inspection. Request Form 98282 for full information.
16-7b *Taylor Instrument Co.

Recorder.....Marksman strip chart potentiometer recorder is free of vacuum tubes, operates instantly (without warm-up), functions longer without maintenance. Details in Bulletin M.
216G West Instrument Corp.

Recorders & Controllers.....Wheelco instruments provide outstanding operating characteristics and feature easier adjustment, inspection and maintenance. Send for informative Bulletin F-7955.
196 *Barber-Colman Co.

Switch, Pressure.....Electroset pressure switch is adjustable from remote position. It operates under severe environment from atmospheric pressure to vacuum with 2 mm. Hg accuracy. Bulletin 1570.
216H Trans-Sonics.

Thermometers, Resistance.....15 p. booklet discusses use of platinum resistance thermometers in temperature measurement, telemetry and control. Includes types and characteristics of specific types.
216I Trans-Sonics.

* From advertisement, this issue

Pipe, Fittings, Valves

Fittings.....Camco extra heavy fittings are machined from solid drop forgings and are recommended for severe pressure-temperature conditions. Catalog 657 and Flange Dimensional Slide Rule.
178 *Camco Products Inc.

Fittings & Flanges.....Drop forged steel fittings and flanges have unmatched strength and toughness for your most severe pipeline duties. Catalog F-9 contains data on complete line.
120 *Henry Vogt Machine Co.

Flanges, Pipe.....Molded rigid PVC pipe flanges are available for use in PVC and other plastic pipe installations. Threaded, socket, blind and reducing flanges come in both sizes. Bulletin PF1200.
217A Luzerne Rubber Co.

Joints, Expansion.....Process piping of any kind can be fully protected with one or more Zallea expansion joints. From the complete line, you can select the suitable expansion joints. Catalog 56.
110 *Zallea Brothers.

Tubing, Alloy.....Alloy sales letter No. 290 furnishes information on high temperature strength properties of Croloy 16-13-3 (TP316) seamless tubing. Results of short time tensile, creep rupture tests.
217B Babcock & Wilcox Co.

Valve, Check.....Modified Techno-check check valve has internal viscous dampener. It serves where hydraulic and air shocks of magnitude are encountered. Advantages include low pressure drop. Bulletin VD-2.
217C Techno Corp.

Valve, Drain.....Solenoid-operated drain valve, originally designed for industrial laundries, may be used wherever controlled draining or dumping of liquids is required. Request Bulletin 8339.
217D Automatic Switch Co.

Valve, Gate.....4 p. booklet contains data on Flex-Plug all-plastic gate valve. Valve combines no-pressure drop construction of gate valve and flow-control feature of globe valve. Request your copy.
217E Vanton Pump & Equipment Corp.

Valves, Gate.....4 p. illustrated bulletin describes 150-lb. and 300-lb. cast steel gate valves. Lists valve features; provides dimension, weight charts; line drawings for each type.
217F Walworth Co.

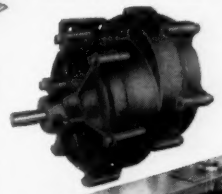
Valve Globe.....Hancock PVC, Y-pattern globe valve handles a wide range of applications, particularly acids and alkalis. Sizes: ½ in. through 3 in. Service rating: 125 psi., 145 F. Bulletin 290.
217G Manning, Maxwell & Moore.

Valves, Lubricated Plug.....Lubricated plug valves stay in service longer than ordinary valves because the seating areas between plug and body are never exposed to the line. Booklet V-203.
67 *Rockwell Mfg. Co.

* From advertisement, this issue

AJAX LO-VEYORS
are cutting costs
in Large Plants
in Small Plants

AJAX Open Pan Lo-Veyor


AJAX-Shaler-Shaker Drive

AJAX Closed Pan Lo-Veyor

AJAX Tubular Lo-Veyor

Plant layout men know that materials flow lines are never a static affair. That's why more and more AJAX LO-VEYORS are being used to give maximum flexibility to operations in large plants and small plants, indoors and outdoors.

AJAX LO-VEYORS are compact, self-contained units that can be suspended from ceilings, along walls, under or at floor levels, giving maximum flow capacity in limited space. They can be quickly and easily installed and or relocated with a minimum of cost and production down time.

AJAX LO-VEYORS in open and closed pan and tubular types meet every requirement of tonnage, speed, sanitation, abrasive and explosive conditions.

Write the factory TODAY for Bulletin No. 39 and name of your nearby AJAX Representative.

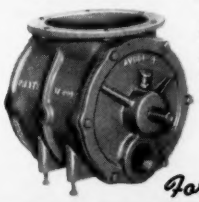
AJAX FLEXIBLE COUPLING CO. INC.
WESTFIELD, N. Y.

PRATER CAN Solve YOUR AIRLOCK FEEDER PROBLEM!

More than 2000 different Prater Airlock applications have solved processing requirements for 300 concerns. You'll find there IS a Prater Airlock for your need . . . from low pressure dust control to high pressure pneumatic conveying.

STANDARD DUTY
Principally adapted for sealing off collectors against air leakage.
Four Sizes . . . 6″, 8″, 10″ and 12″.

HEAVY DUTY
For applications involving high pressure Pneumatic Conveying or Volumetric feeding of finely ground materials.
Four Sizes . . . 6″, 8″, 10″ and 12″.



BLOW-THRU
For pneumatic conveying systems handling flour or similar fine powder or granular material.
Available for 2″, 3″ or 4″ Conveying Lines.

Send for informative Booklet P-55
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SPECIALIZED WELDED HEAT AND CORROSION RESISTANT **FABRICATIONS**

for example

VACUUM RETORTS

This heavy INCONEL Vacuum Retort is one of a number of such designs being produced by ROLOCK. Approximately 2 feet in diameter by 8 feet high, it is used for high-temperature vacuum annealing.

By entrusting such work to ROLOCK, you gain the many advantages of competent engineering supervision; production personnel thoroughly experienced in the problems and materials involved; a modern plant fully equipped for inspection and testing as well as fabrication.

Rolock facilities and skills cover a wide range of work in pressure and vacuum equipment, specialized processing carriers, furnace retorts, covers and bells, trays, tanks, fabrications and assemblies in Inconel, Incoloy, Monel, the Hastelloys, and Stainless Steels. Send us an outline of your requirements.

Put your problems up to:

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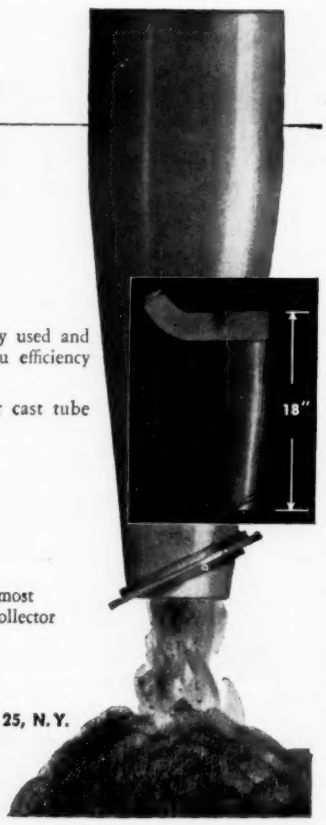
new, improved **DUSTEX COLLECTOR**

solves more recovery problems...costs less to install...



A major design improvement on the widely used and highly regarded DUSTEX Collector assures you efficiency —*superior to collectors costing much more.*

ALL NEW TUBE DESIGN—Longer, larger cast tube produces the following results...

- **Greater capacity with less air flow resistance**
- **Higher abrasion resistance**
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- **Self-cleaning action**
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ALREADY PROVEN in numerous field tests on the most difficult dusts, the new improved DUSTEX Collector is ready to go to work for you now. Write for descriptive literature and details today.

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DUSTEX CORP.

Process Equipment

Centrifuge.....Batch-o-matic bottom discharge centrifugal duplicates operation of any batch type centrifugal. Loading, extraction, unloading speeds can be changed in the field if needed.
218A Tolhurst Centrifugals Div.

Cleaners, Air & Steam.....Filter-free, maintenance-free Hi-eF Model LC purifiers are installed like pipe fitting on compressed air pipelines, just before pneumatic equipment. Bulletin 502.
218B V. D. Anderson Co.

Compacting Equipment.....Fine by-product material is densified into slabs or flakes in a compacting mill, then granulated in a roller-type mill and separated in a vibrating screen. Bul. 07B8836.
111 *Allis-Chalmers Mfg. Co.

Deaerator.....Tray type deaerator effectively removes corrosive gases from boiler feed water. Available in sizes with effluent capacity from 18,000 lb./hr. to more than 2,000,000 lb./hr. Bull. 28B8853.
218C Allis-Chalmers Mfg. Co.

Dehydrators.....With Selas dehydrators moisture removal and discharge from system is continuous, with no flow interruption or interference. Gases handled include hydrocarbons, CO_2, N_2, H_2. Bulletin SC-1013.
218D Selas Corp. of America.

Dryers.....Whether your controls call for large or small amounts of air, there are Lectrodryers in sizes to suit, to keep vaporous moisture out of instruments, valves and air motors. Bulletin 223B.
46 *Pittsburgh Lectrodryer Div.

Dryers.....Company offers complete "Pilot" drying facilities to prospective customers. Test dryers find the exact requirements for your application. Bulletin on facilities and dryer types.
T219 *Standard Steel Corp.

Dryers.....12 p. bulletin describes models of heatless, self-activating, zero-dewpoint dryers designed to prevent moisture fouling of instruments, controls, chemicals, gases, etc.
218E Van Products Co.

Dust Collectors....."The Collection and Recovery of Industrial Dusts" contains specific information about all three Buell dust collection systems, Cyclone, electric precipitator and combination.
40 *Buell Engineering Co.

Feeders, Rotary Airlock.....There is an Airlock feeder for every need from low pressure dust control to high pressure pneumatic conveying. Standard, heavy duty and blow-through types. Bul. P-55.
B217 *Prater Pulverizer Co.

Filters.....Fulflo filters give true depth filtration, at minimum pressure drop, for high or low flow rate, pressure, pH, temperature and viscosity. Provide the desired microclarity. Catalog.
30 *Commercial Filters Corp.

* From advertisement, this issue

Filters, Cone.....Dewatering cone filters discharge dewatered, granular materials at constant moisture content regardless of moisture in feed. Current model has 6-ft. dia. cone. Bulletin CFB-101.
219A Carpco Mfg.

Generators, Inert Gas.....Inert gas generators end the trouble and expense of bottled gas and provide a highly flexible source of supply at a fraction of the cast. Request Bulletin I-10 now.
37 *C. M. Kemp Mfg. Co.

Mills, Grinding.....Nordberg grinding mills are made in sizes ranging from 6 to 13 feet in diameter and up to 50 feet in length. Types include rod, ball, pebble, tube and compartment mills. Bul. 232.
6-7 *Nordberg Mfg. Co.

Mixers.....Company's mixers have oversize, heavy duty, high capacity bearings for longer life, less maintenance, extra strength and rigidity. Catalog A-27 holds complete information on line.
28 *Phila. Gear Works.

Process Equipment.....If you dewater slurries, you should have the facts about vertical Super-D-Canters, models P-7000 and P-4000. Capacity is upwards of 250 gpm. liquids, 10-12 tons/hr solids.
89 *Sharples Corp.

Process Equipment, Mills.....Disc-Roll mill is a roller-type mill with two adjustable, pneumatically loaded rolls for grinding on a rotating disc or table. Also air classifier. Bul. 52-11.
181 *Hardinge Co.

Processing Equipment.....32-page report entitled "Data for Cost Estimation" presents costs and equipment specifications on line of standard impervious graphite processing equipment. Bul. 249.
195 *Falls Industries Inc.

Proportioner, Stock.....Sprout-Waldron/Cowan stock proportioner is designed for uniform, accurate volumetric metering of pulps. Bulletin 191 illustrates two types: overflow and control level.
219B Sprout, Waldron & Co.

Refiner, Pulp.....Model 36-2 single rotating disc pulp refiner is designed for pulping applications where rubbing and brushing (without cutting) is required. Bulletin 96-B.
219C Sprout, Waldron & Co.

Shaker, Sieve.....Dynamic sieve shaker gives same accurate and complete sieving of all types of materials formerly separated on larger and heavier shakers. Can be used for field, lab and production sieving.
219D Soiltest.

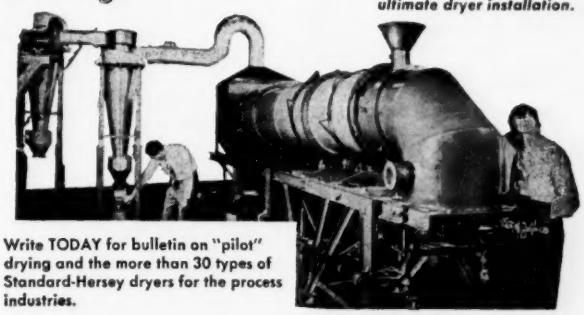
Wire Cloth & Filter Elements..... Wire cloth and filter cloth, "Neva-Clog" and "Mykro-Pore" metal filter media, filter leaves, screens, tubular filter elements are among products. Catalog 57.
189 *Multi-Metal Wire Cloth Co.

Wire Cloth & Screens.....L-S wire cloth and screens have proved far superior in resisting abrasion, corrosion, high pressure, heat and vibration. Made in several metals. Screen Reference Cat.
194 *Ludlow-Saylor Wire Cloth.

* From advertisement, this issue

how STANDARD HERSEY TEST DRYING can save you money!

Standard Steel Corporation offers its complete "Pilot" drying facilities to customers and prospective customers. Standard-Hersey test dryers, like the one illustrated below, can be adjusted to duplicate the performance of any type rotary dryer. You learn in advance the exact requirements for your individual dryer application. This eliminates guesswork and in nearly all cases results in substantial savings in your ultimate dryer installation.



Write TODAY for bulletin on "pilot" drying and the more than 30 types of Standard-Hersey dryers for the process industries.

STANDARD STEEL CORPORATION
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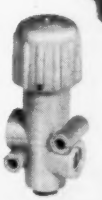
(Division of Standard Steel Corporation)
ROTARY DRYERS • KILNS • COOLERS • ASPHALT PLANTS

SLASH MAINTENANCE AND REPLACEMENT COSTS . . . .
with CHEMTROL *the Only* COMPLETE *Line of Plastic Valves, 1/8" I.P.S. to 3" I.P.S.*

Lower first costs and virtually unlimited service life are yours when you specify Chemtrol corrosion-service plastic valves. With outstanding and constant flow characteristics, they operate successfully in corrosive environments too severe for ordinary valves. Available in PVC (Polyvinyl Chloride), Types I and II; Kralastic**; Penton*; Polypropylene (Pro-fax*); and other co-polymers, Chemtrol valves are immediately available in widest ranges of sizes and types from over 500 sources across the nation.

Write or Phone for Complete Application Information and Service Recommendations

BALL VALVES
Compact, "stick-proof". Full-flow and quick acting



Micro-Flow GLOBE VALVE
Fast opening and closing. Precise throttling control

Micro-Meter NEEDLE VALVE
Precision metering and recording of settings

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** NAUGATUCK CHEMICAL CO. TRADEMARK

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Get the **LEVEL READINGS** of **LIQUIDS THAT BOIL** and Flash

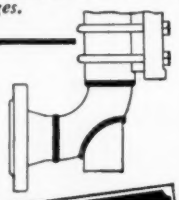
Jerguson Large Chamber Gage

The Jerguson Large Chamber Gage is designed to indicate the level of liquids whose tendency to boil and flash makes an accurate level reading impossible with ordinary gages.

The chamber of this Jerguson Gage is of such large diameter that the level is not badly upset by boiling action of the fluid. This makes possible close level readings, the kind you want and need for accurate control and safety.

You don't have to be satisfied with gages that require guessing at level readings. If liquids boil, install Jerguson Large Chamber Gages and be sure of the liquid level.

The Jerguson Large Chamber Gage is available in reflex and transparent types. Write for full information on this and other Jerguson Gages.



Tapped ¾" pipe threads standard. Available with 2" flanged ends for direct connection to vessel.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

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Offices in Major Cities
Jerguson Tress Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France

LITERATURE . . .

Pumps, Blowers, Compressors

Pumps.....Recently released bulletin on the effects of redial loads in process pumps, entitled "Mechanical Consideration in Pump Design", is an example of company's research. Bulletin EM-79.
104 *Peerless Pump Div.

Pumps.....New 200 D.O. corrosion-resistant positive displacement pump has up to 300 G.P.M. capacity, yet is only 17 inches high. Large inlet and outlet ports, larger impeller. Bulletin.
161 *Waukesha Foundry Co.

Pumps, Centrifugal....Company maintains a factory stock of the most commonly used sizes of centrifugal pumps for immediate delivery. Leak-proof, self-lubricating seals. Catalog CSP-257A.
107 *Bell & Gossett Co.

Pump, Centrifugal.....Type SZ single-stage, single-suction, non-priming centrifugal pump combines long service life and efficiency with minimum repair and maintenance cost. Bulletin D-3.
220A LaBour Co.

Pumps, Chemical.....Complete line includes ten specially designed pumps for chemical liquids. Can handle a wide variety of corrosive, abrasive or high-consistency liquids. Bulletin 982-A.
98c *Buffalo Pumps Div.

Pumps, Double Suction.....Buffalo Type "SL" double suction pump is recognized for its highly efficient clear water service throughout industry. Capacities from 10 to 14,000 gpm. Bul. 955-R.
98a *Buffalo Pumps Div.

Pumps, High Pressure.....Type "RR" multi-stage pump is ruggedly engineered to deliver peak efficiency on boiler feed and other clear water applications against heads as high as 1500 ft. Bul. 980-D.
98b *Buffalo Pumps Div.

Pumps, High Vacuum.....New Roots mechanical high-vacuum pump works without the aid of oil or steam vapors. It has no shaft seals, no leaks, no by-pass or valving. Fast, quiet. Bulletin P8-20.
190a *Consol. Electrodynamics.

Pumps, Non-Clogging.....Diagonally split-shell pumps are designed for moving high-consistency liquids, with downtime reduced to an absolute minimum. Several models available. Bul. 953-K.
98d *Buffalo Pumps Div.

Pumps, Suction.....End suction type BC general purpose pumps have low NPSH characteristics for critical suction conditions; can be changed from packing to seals via interchangeable parts. Bul. 119-C.
220B Aurora Pump Div.

Services, Processes, Misc.

*From advertisement, this issue

he's working for you

THIS FELLOW IS TRAINED IN YOUR BUSINESS. His main duty is to travel the country — and world — penetrating the plants, laboratories and management councils . . . reporting back to you every significant innovation in technology, selling tactics, management strategy. He functions as your all-seeing, all-hearing, all-reporting business communications system.

THE MAN WE MEAN IS A COMPOSITE of the editorial staff of this magazine. For, obviously, no one individual could ever accomplish such a vast business news job. It's the result of many qualified men of diversified and specialized talents.

AND, THERE'S ANOTHER SIDE TO THIS "COMPOSITE MAN," another complete news service which complements the editorial section of this magazine — the advertising pages. It's been said that in a business publication the editorial pages tell "how they do it" — "they" being all the industry's front line of innovators and improvers—and the advertising pages tell "with what." Each issue unfolds an industrial exposition before you — giving a ready panorama of up-to-date tools, materials, equipment.

SUCH A "MAN" IS ON YOUR PAYROLL. Be sure to "listen" regularly and carefully to the practical business information he gathers.

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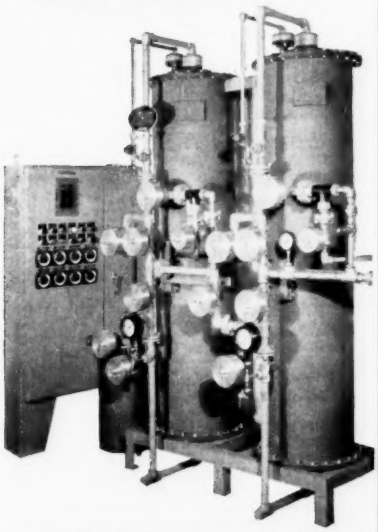
Now!
NEW IDEAS IN AN EFFICIENT . . .



AUTOMATIC DE-IONIZER

New, simplified, pneumatic ILLCO-MATIC valve-operators, designed and built especially for this service, are featured on the two-bed Automatic De-Ionizer shown above. *ILLCO-WAY Two-Bed or Mixed-Bed De-Ionizers, equipped for automatic operation, can be built to any service or cycle your processes require.*

EASILY ADJUSTABLE

The control panel for ILLCO-WAY Automatic De-Ionizers features a set of adjustable Timers, one for each operation. Instant readjustment of the time of any cycle is thus possible, giving the user full flexibility to meet any conditions. Automatic sensing devices can be set to start the regeneration cycle under any specified requirements. *For further details, consult your ILLCO-WAY representative, or write to . . .*

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LITERATURE . . .

Air Pollution Control.....Oxy-Catalyst systems for air pollution control and waste heat recovery can clean up close to 100% of combustible pollutants and odors. New brochure give facts and figures.
BR223 *Oxy-Catalyst Inc.

Atomic Energy Reports.....More than 4,500 unclassified Atomic Energy Commissoin research reports are listed in the government's semi-annual price list, which is now available. TD 1327.
183-4n *U. S. Industrial Chem. Co.

Atomic Power.....2-color brochure describes facilities and accomplishments of atomic power department of United Shoe Machinery Corp. Describes organization's contributions to various nuclear programs.
221A United Shoe Machinery Corp.

Chemical Literature.....A 398-page guide describes and classifies chemical literature, analyzes kinds of chemical literature, discusses ways of keeping current. Request information on TD 1321.
183-4g *U. S. Industrial Chem. Co.

Extrusions, Plastic.....4 p. brochure describes extrusion of thermoplastic materials—advantages of extrusion, engineering service, dies used and custom shapes provided by Pyramid Plastics.
221B Pyramid Plastics.

Facilities, Equipment.....Bulletin 201 gives information on facilities, products, personnel on General Metals of Greensboro, N. C., fabricators of steel, aluminum, stainless steel, metal products.
221C General Metals.

Filing Costs.....28 p. manual, "How to Measure Your Filing Costs and Efficiency," offers formulas for "finding efficiency," "filing reference rate," "file clerk efficiency," plus other practical tools.
221D Remington Rand.

Fire Protection.....One all-purpose foam fights all flammable liquid fires and is ideally suited for spot protection systems and inplant fire trucks. Send for illustrated booklet today.
169 *Rockwood Sprinkler Co.

Gloves, Industrial.....Illustrated catalog gives complete specs and information on line of liquid-proof industrial gloves. Also selector check list to pick right glove for right job.
221E Pioneer Rubber Co.

Monitor, Radiation.....Portal radiation monitor efficiently monitors personnel for gamma and hard beta radiation due to radioactive contamination. Can be placed in any entrance or exit. Bulletin N-6.
221F Nucleonic Corp. of America.

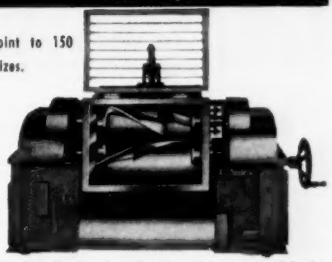
Oil Reclaimer Systems.....Hilco oil reclaimers purify vacuum pump oil by continuous recirculation. They produce and maintain oil free of solids, sludge, acid, moisture and solvents. Bulletin R-160.
182 *Hilliard Corp.

Television, Industrial.....You'll be amazed at the versatility, simple operation and low cost of GPL closed-circuit industrial television. Request free, illustrated bulletin, "How Many Jobs".
R172 *General Precision Lab.

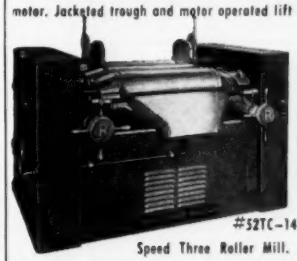
*From advertisement, this issue

Ross
Leading mfrs. of
MIXING AND GRINDING EQUIPMENT
for over 90 years

• 1 pint to 150 gal. sizes.



#41L–10 Gal. Double Arm Kneader with two speed brake motor. Jacketed trough and motor operated lift optional.

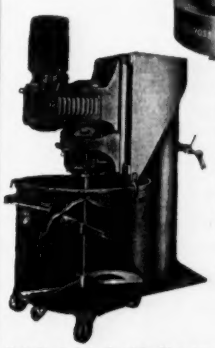


• 4½ x 10, 6 x 14, 9 x 24, 12 x 30, 14 x 32, 16 x 40" sizes.

#52TC–14" x 32" High Speed Three Roller Mill. Hydraulic adjustment and pressure recording gauges optional.

#30C–50 Gal. Heavy Duty Change Can Mixer. Adjustable outer scraper, cover with charging port, and gates on cans optional.

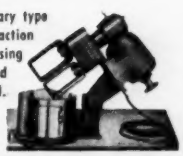
• 8, 16, 20, 50 and 60 gal. sizes.



#130H–250 Gal. Change Tank Mixer with hydraulic raising and lowering and variable speed motor. Various type stirrers and high speed impellers optional.

• 80,150 and 250 gal. sizes.

#130EL–1 Gal. Double Planetary type Change Can Mixer with shearing action stirrers, and variable speed reversing type motor. Jacketed cans and portable trucks for cans optional.

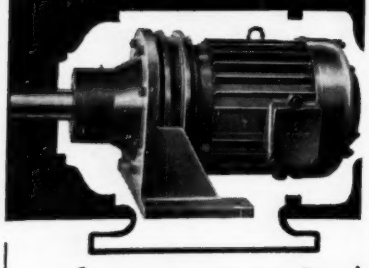


• 1, 2, 3, 4, 6, 15, 25, 50, 65, 85, 110 and 150 gal. sizes.

Write for complete information on these or other types of Ross equipment.

CHARLES ROSS & SON COMPANY, INC.
152 CLASSON AVENUE
BROOKLYN 5, NEW YORK

SPEED REDUCER & MOTOR



IN THE SPACE OF A MOTOR ALONE!

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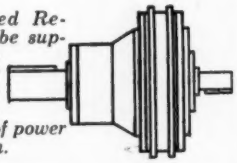
Cyclo Speed Reducers can be supplied with or without motor. Note coaxial arrangement of power transmission.



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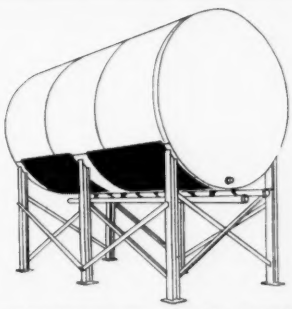

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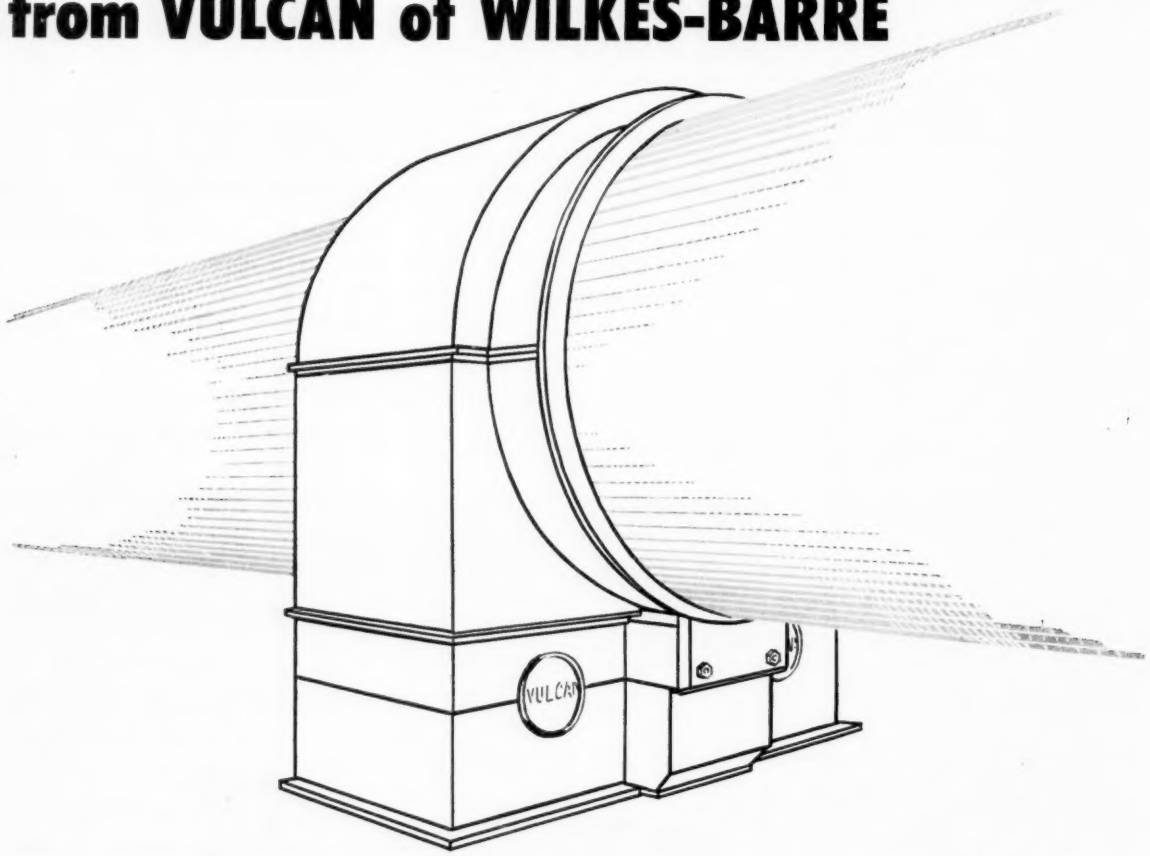

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1—Pfaudler 100 gal. S.S., jacketed, agitated, Reactor, XP motor.
3—Pfaudler 500 and 300 gal. glass lined, jacketed Reactors.
1—600 gal., 316 S.S. jacketed, agitated Reactor 200# internal pressure, 75#.
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1—Baker Perkins No. 16 TRM 150 gal. jacketed, sigma blades, Vacuum.
1—Baker Perkins 50 gal. jacketed, Sigma blades.
5—Day "Cincinnatus" double arm 250 and 100 gals.
5—Steel Powder 50, 225 and 350 cu. ft.
1—10 cu. ft. "V" Blender, 304 S.S.
1—Eppenbach 1 HP, 304 S.S. Homo Mixer.

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3—Bartlett & Snow 7'x30', 6'x30' Rotary.
1—H&B 5'x30' direct heat Rotary.
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2—Devine 4'x9' Atmospheric single drum.
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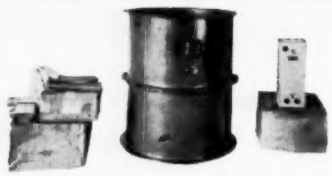

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1—Tolhurst 32" Suspended Type Centrifuge with stainless steel Perforate Basket, plow and curb, 25/12½ HP motor
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THE GELB GIRL—FEBRUARY 1958

2—Baker Perkins Double Arm Sigma Blade Jacketed Mixers, 100 gallons
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1—Banbury Midget Pilot Plant Mixer
3—Robinson Type 316 Stainless Steel Sigma Type Jacketed Heavy Duty Mixers, 400 gallon capacity, 60 HP
1—Leader Stainless Steel Jacketed Horizontal Ribbon Blenders, 40 cu. ft.
1—Process Engineers Stainless Steel Jacketed Ribbon Blender, 30 cu. ft.

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4—Type 317 Stainless Steel Heat Exchangers, 892 Sq. ft. ea., 200 PSI
2—Struthers Wells Type 316 Stainless Steel Reboilers, 445 sq. ft. and 380 sq. ft.
6—Karbate 60 sq. ft. Heat Exchangers
2—Combustion Engineers Water Tube Package Boilers, 200 HP, 275 pressure
1—Komarek Greaves Briquetting Machine with 50 HP motor
1—Ingersoll Rand Air Compressor with 300 HP motor, 1600 CFM, 100# pressure
1—Williams 4-roll Mill, Complete
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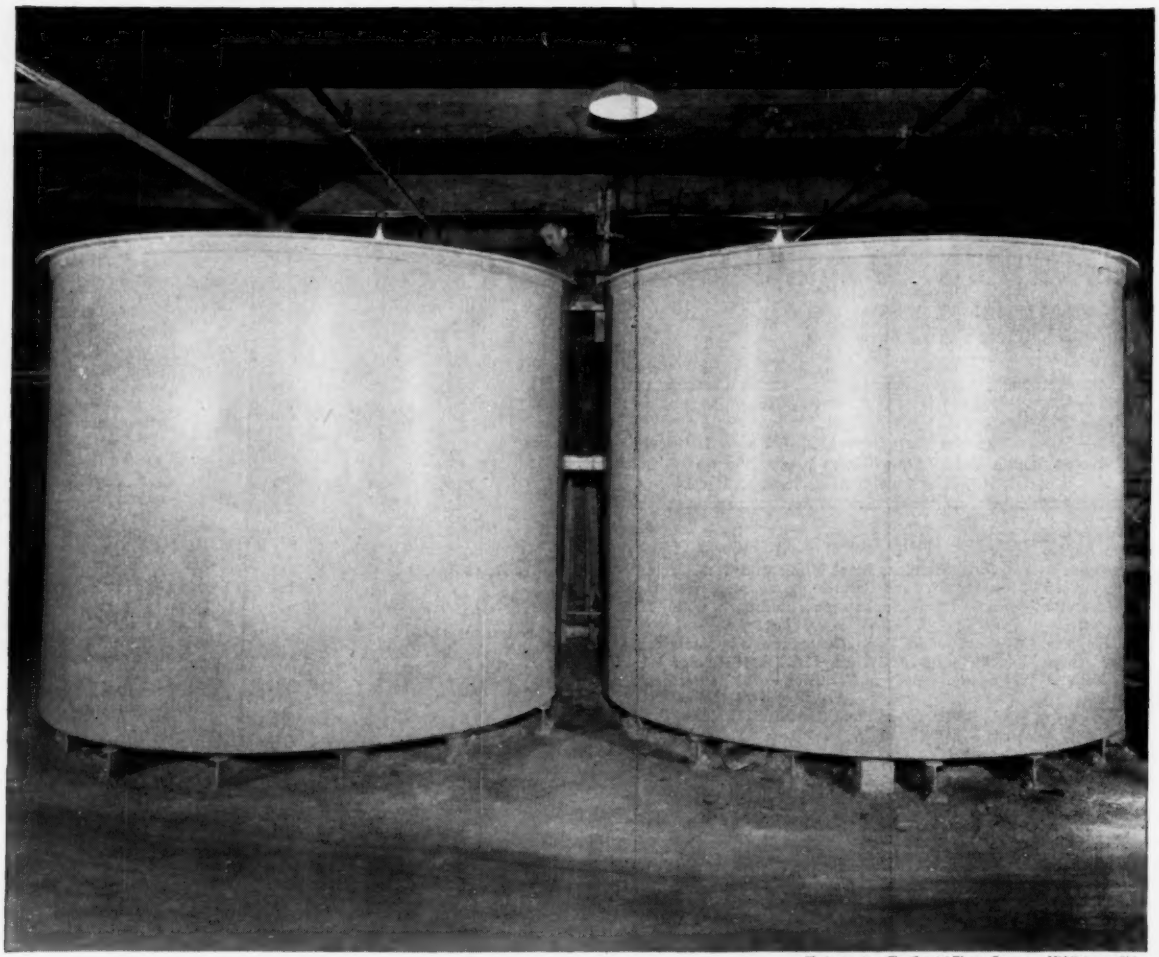

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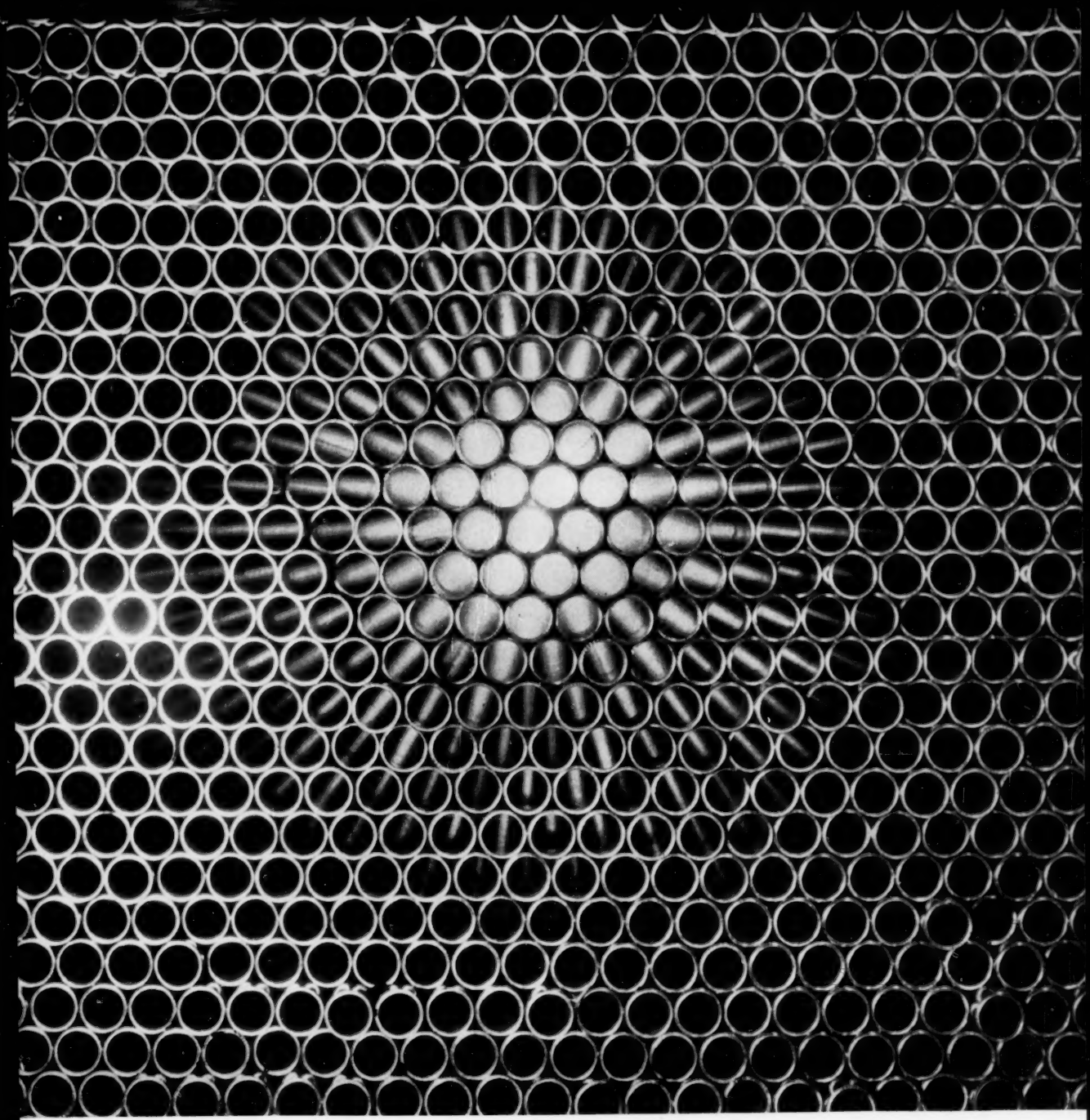

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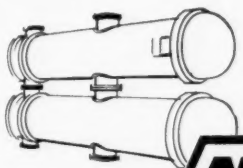

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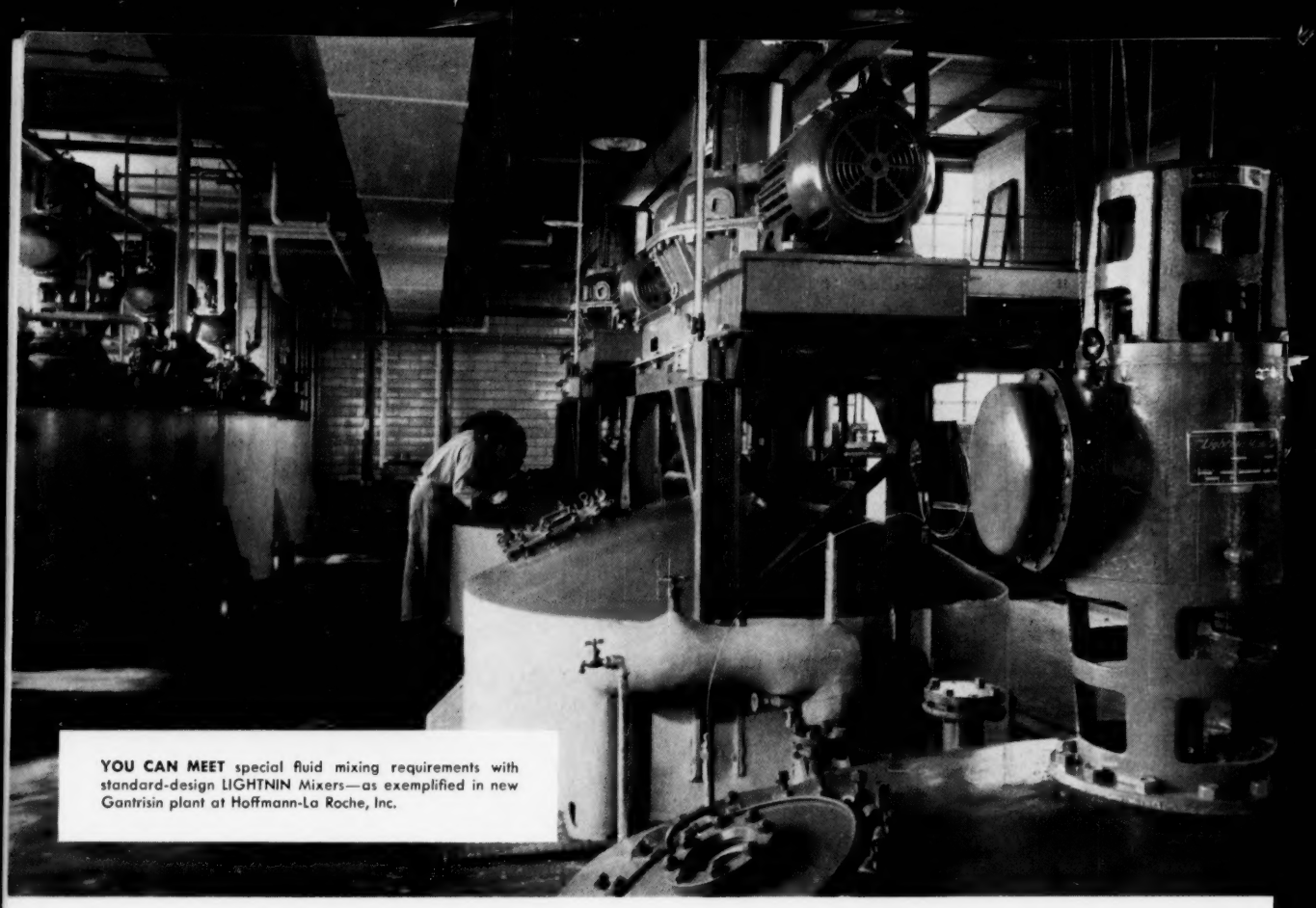

YOU CAN MEET special fluid mixing requirements with standard-design LIGHTNIN Mixers—as exemplified in new Gantrisin plant at Hoffmann-La Roche, Inc.

Good mixing helps clear up tough crystallization problem

Does formation of uniform crystals pose a tricky processing problem for you? Maybe the answer lies in good mechanical mixing.

This is true at Hoffmann-La Roche, Inc., Nutley, N. J., where a highly automated new plant has started turning out Gantrisin, a broad-spectrum sulfa drug, at double the previous rate and with 40% less manpower.

Mixer prevents clogging

Crystal formation takes place in brine-cooled kettles, which are constantly mixed from 10 to 12 hours while batch temperature drops from 200° F to 30° F.

Thorough mixing is essential, since an unevenly cooled batch can cause clogging of the bottom outlet, and expensive time loss.

As viscosity increases in the cooling batch, load on the mixer builds up sharply. In addition, extremely small clearance is required between the mixer impellers and vessel wall.

Could Hoffmann-La Roche satisfy all these conditions without going to special mixer design?

Could—and did

Not only in the crystallizers, but in every fluid mixing operation in the new process, Hoffmann-La Roche meets the requirements with *standard-design* LIGHTNIN Mixers.

Nine LIGHTNINS, ranging in size from 3 to 40 HP, perform a variety of mixing jobs—and enable Hoffmann-La Roche to standardize on spare parts, simplify maintenance routine and operator training.

The company has used LIGHTNINS for more than 20 years; currently has more than 200 in operation.

Reduce long-term cost

No matter how specialized your processing needs may be, it costs you nothing to determine whether LIGHTNIN Mixers can meet them. And when you specify LIGHTNINS, you get *guaranteed* mixing results, based on unique scale-up data from many thousands of pilot runs.

You enjoy the long-term cost advantage of *standard* mixer construction, with interchangeable parts and components always available.

And you save further with "flex-protected" design and many other refinements that keep your maintenance costs low.

For quick, competent help on fluid mixing, see your LIGHTNIN Mixer representative now. He's listed in Chemical Engineering Catalog. Or write us direct.

What Mixing Operations are important to you? You'll find a wealth of information on fluid mixing in these helpful bulletins describing LIGHTNIN Mixers:

- ☐ Top or bottom entering; turbine, paddle, and propeller types: 1 to 500 HP (B-102)
- ☐ Top entering; propeller types: ¼ to 3 HP (B-103)
- ☐ Portable: ⅛ to 3 HP (B-108)
- ☐ Side entering: 1 to 25 HP (B-104)
- ☐ Laboratory and small-batch production types (B-112)
- ☐ Condensed catalog showing all types (B-109)
- ☐ Quick-change rotary mechanical seals for pressure and vacuum mixing (B-111)
- ☐ Confidential data sheet for figuring your mixer requirements (B-107)
- ☐ LIGHTNIN CM Contactor for processing fluids continuously (B-515)

Check, clip and mail with your name, title, company address to:

MIXING EQUIPMENT Co., Inc., 128-b Mt. Read Blvd., Rochester 11, N.Y.

In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Avenue, Toronto 10, Ont.

Lightnin® Mixers™

MIXCO fluid mixing specialists